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Pine Shoot Insects Common in British Columbia

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Pine Shoot Insects Common in British Columbia

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ABSTRACT

This publication is an aid to the identification of pine shoot insects on pines native to British Columbia. Eighty-five insect genera are referenced, including 75 species. The most important species are described, and keys to immature stages and their damage symptoms are presented; scientific, family and common names are given. Three major tree species are involved - one is divided into two varieties. Sixty-six color photographs, a host distribution map, a glossary, references and an index are provided.

RESUME

Ce document aidera à identifier les insectes des pousses du Pin sur les pins indigènes du Colombie-Britannique. Le répertoire contient 85 genres d'insectes, incluant 75 espèces. Les plus importantes espèces y sont décrites et des clés des stades larvaires et des symptômes de leurs dégâts sont présentées; les noms scientifiques, de famille et communs sont indiqués. Trois espèces d'arbres sont impliquées dont une divisée en deux variétés. Le document contient 66 photographies en couleurs, une carte sur l'aire de distribution, en plus d'un glossaire, de notes bibliographiques et d'un index.

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CONTENTS

Page

MAP 4

INTRODUCTION 5

IMPORTANT INSECTS

Key to immature insects 6

Key to damage 8

Descriptions of species 13

COMMON INSECTS OF LIMITED LOCAL SIGNIFICANCE

Descriptions of species 34

ASSOCIATE INSECTS

Incidental feeders 51

Parasitoids and predators 52

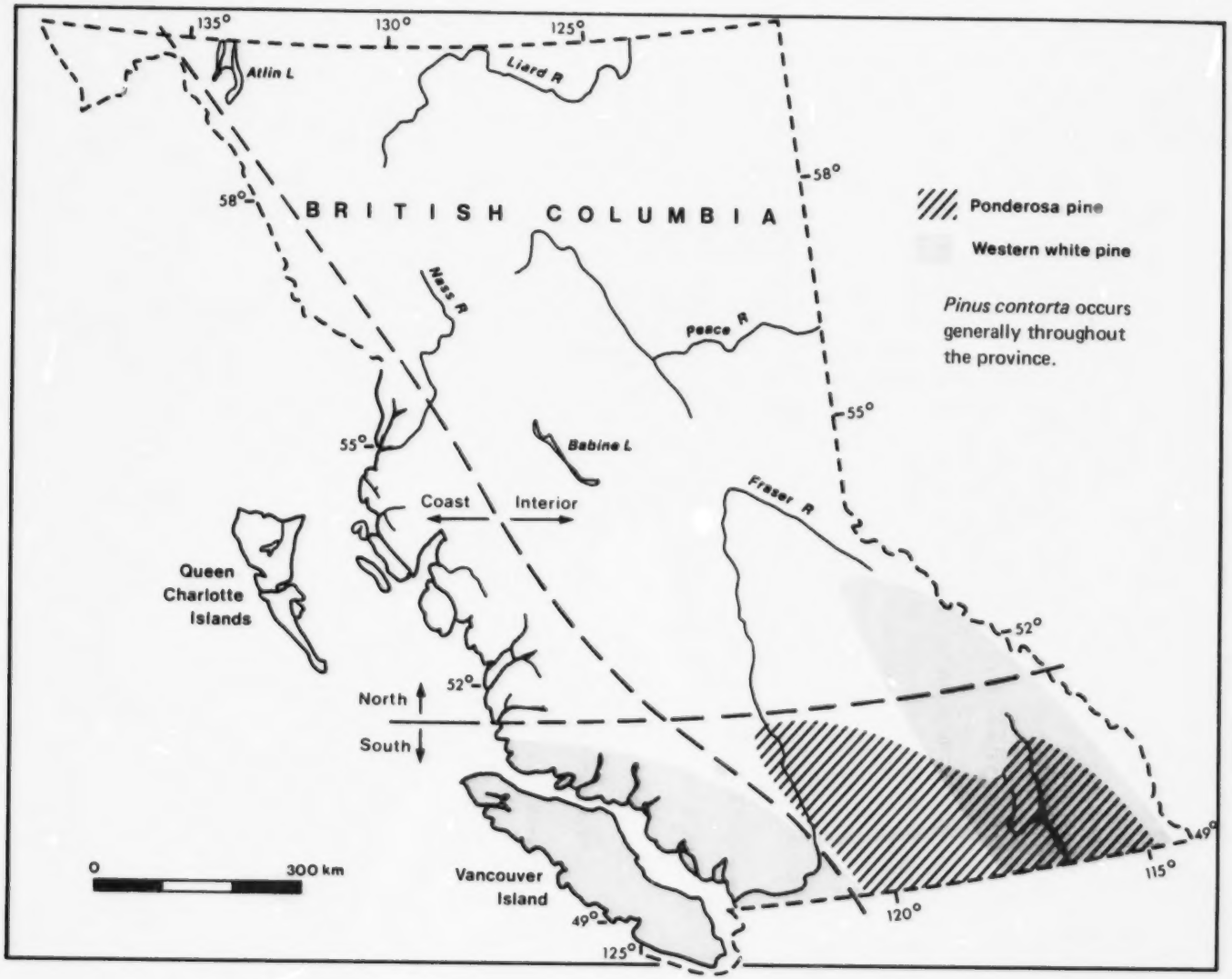
Sheltering insects 53

ACKNOWLEDGMENTS 53

GLOSSARY 54

REFERENCES 55

INDEX 56



The regions of British Columbia as used in the text.

INTRODUCTION

The prompt recognition of insect pests becomes more important as the use and value of pine increases. This publication is designed to aid nursery, plantation and forestry workers in the indentification of shoot insects on native pines, particularly those insects of economic significance. Data were derived from observations and material collected throughout British Columbia during 1970-1980, augmented by records of the Forest Insect and Disease Survey and literature research. Shoot insects are herein considered as those that ordinarily feed on buds, candles, flowers or any part of the current terminal growth on branches or leaders. Insects restricted to cones, seeds, bark, wood or roots are excluded, as are physiological and disease damage; however, mites are listed. Most of the insect species are common but some have not been studied in detail.

Shoot insects, as a group, include some of the most injurious pine pests, and many of the defoliating insects begin their feeding cycle in the buds. The species have been arranged in alphabetic sequence by generic name into three arbitrary groups, according to damage potential: 1, important species; 2, common species; and 3, associate species; placement could change subject to environmental and economic factors. Important species are insects known to cause permanent tree injuries such as growth loss, deformity, stunting and general weakening through defoliation, boring or sap feeding. Common species are those frequently abundant or conspicuous by their feeding habits, but seldom causing serious damage; some are pests elsewhere but have not yet been a problem in British Columbia. Associate species are: a) incidental feeders – frequently noticed but primarily feeding on other parts of the tree or on other host plants; b) parasitoids and predators – common to pine insects, but not necessarily restricted to them; and c) sheltering insects – often found on pine shoots but not feeding on them. Several hundred associate species have been recorded; the most common have been listed but not indexed. Such data are contained in an annotated checklist now in preparation.

The keys include only those species listed as important, and additional distinguishing characteristics are given in the text. Life cycles of the important species are described, with emphasis on detection, identification and economic status. Scientific names are used, recent name changes are indicated, and common names approved by the Entomological Society of America are capitalized in the index.

Species of pines native to British Columbia are: ponderosa pine (*Pinus ponderosa* Lawson), from the lower altitudes of the southern interior; lodgepole pine (*P. contorta* Douglas var. *latifolia* Engelmann), throughout the interior; the coastal shore pine (*P. contorta* var. *contorta*), and western white pine (*P. monticola* Douglas), from the south, excluding the western interior. Sub-alpine limber pine (*P. flexilis* James), which occurs locally in the southern Rocky Mountain area, and alpine whitebark pine (*P. albicaulis* Engelmann), south of 55^{o} latitude, are excluded, because of their general inaccessibility and limited distribution, relatively little data are available. Exotic species of pines have not been considered.

IMPORTANT INSECTS

KEY TO IMMATURE INSECTS

Bracketed numbers indicate the derivation of the couplet. Allowances have been made for early-instar larvae where practical, however, young larvae are seldom detected.

1.		Larva apparently legless; no conspicuous spines	2
		Larva obviously with legs; or, if legs inconspicuous, then body with large terminal spine-like appendages	8
2.	(1)	Yellow, orange, pink or red	*Cecidomyia* spp. p. 15
		Black, brown or white (cream)	3
3.	(2)	A borer; smooth and cream-colored with a distinct brown head	4
		A surface feeder, usually sessile; black, white or pale brown, usually with a powdery or waxy covering; head not apparent	6
4.	(3)	Mature larva approximately 8 mm long; in a straight tunnel down the center of the terminal growth, usually in the leader	*Pissodes terminalis* p. 30
		Mature larva less than 5 mm long; in an irregular tunnel in a twig, bud or cone	5
5.	(4)	Mature larva approximately 4 mm long; usually in a cone or bud	*Conophthorus monticolae* p. 20
		Mature larva approximately 2.5 mm long; usually in a twig	*Pityophthorus* spp. p. 31
6.	(3)	Smooth dark grey with paler margins; limpet-like, oval in outline	*Nuculaspis californica* p. 28
		Pale brown, with smooth white elongate body shell or woolly white covering	7
7.	(6)	Small elongate brown body; usually associated with a conspicuous flat elongate white shell, which is approximately 3 mm long	*Phenacaspis pinifoliae* p. 28
		Fluffy white waxy body covering	*Pineus coloradensis* p. 29
8.	(1)	Four or seven pairs of abdominal prolegs, in addition to the three pairs of true legs; no abdominal spines	9
		No abdominal prolegs; sometimes with conspicuous dark abdominal spine-like appendages	20
9.	(8)	Four pairs of abdominal prolegs	10
		Seven pairs of abdominal prolegs	*Neodiprion* spp. p. 25
10.	(9)	Body dark brown, possibly an obscure pattern or contrasting setal bases; head sometimes black	11
		Drab yellow-green, white or orange-brown, seldom any pattern; head usually dark brown	16

11.(10) Conspicuous dark and light setal bases; head may be nearly black . . . . . *Choristoneura occidentalis* p. 17
Setal bases inconspicuous or entirely dark, no pale markings 12

12.(11) Head smooth and shiny black, thoracic shield entirely black . . . . . *Rhyacionia buoliana* p. 31
Head finely reticulate, dark brown, rarely black; thoracic shield usually lighter and frequently shaded; *Dioryctria* spp. 13

13.(12) Body pink-brown, or with small pale setal bases 14
Body grey/brown, setal bases dark 15

14.(13) Setal bases dark or inconspicuously colored as body; thoracic shield usually darker at ends . . . . . *D. abietivorella* p. 21
Setal bases pale or inconspicuous; thoracic shield evenly colored . . . . . *D. pentictonella* p. 24

15.(13) Setal bases conspicuously large and dark (spots); head light brown . . . . . *D. cambiicola* p. 22
Setal bases small and inconspicuous; head dark brown . . . . . *D. auranticella* p. 22

16.(10) Body allover off-white, with dark head and small thoracic shield . . . . . *Eucosma sonomana* p. 25
Body well pigmented 17

17.(16) Distinct black setal bases . . . . . *Epinotia hopkinsana* p. 24
Setal bases pale or inconspicuous 18

18.(17) Body brown-green, setal bases conspicuous 19
Body orange-brown (drab), setal bases inconspicuous . . . . . *Zelleria haimbachi* p. 33

19.(18) Usually 6 - 9 mm long; head light or mid-brown . . . . . *Argyrotaenia citrana* p. 13
Approximately 4 mm long; head nearly black . . . . . *Coleotechnites* sp. p. 19

20. (8) An aphid: a delicate spindly insect with long thin legs . . . . . *Cinara brevispinosa* p. 17
A sawfly: caterpillar-like; legs small and dark; two conspicuous spine-like appendages at the posterior of the body; *Cephalcia* spp. 21

21.(20) Brown-orange body, brown head; semi-colonial . . . . . *Cephalcia* sp. p. 17
Green body, green head; in massive colonies . . . . . *C. californica* p. 16

KEY TO DAMAGE

The damage key should be used in conjunction with insect specimen material whenever possible. Characteristics vary greatly by insect feeding type and stage and also because of weather, tree age, condition of damage, etc.

1. On *P. contorta* or *P. monticola* 2
   On *P. ponderosa* 28

2. (1) No single tunnel down central twig-stem or candle, foliage not chewed, although possibly discolored; no hollow needles; no webbing 3
   Otherwise, at least one of the above characteristics present 12

3. (2) Interior of (terminal) bud eaten 4
   Damage to foliage, twig-stem or candle 5

4. (3) Mining, usually in leaf buds, January-March at coast, February-April in interior B.C. . . . . *Rhyacionia buoliana* (young instars) p. 31
   Irregular excavations, usually in flower buds, April-May at coast, May-June in interior . . . . . *Conophthorus monticolae* p. 20

5. (3) Candle (or young shoot) crooked at base . . . . . *Cecidomyia* sp. p. 15
   Candle not usually bent 6

6. (5) Small pitch nodules on twig-stem just below candle; foliage more or less evenly discolored; coastal B.C.; *Cecidomyia* spp. 7
   No pitch; foliage not evenly discolored 8

7. (6) Pitch nodules superficial; apical growth may be stunted and some foliage partially discolored . . . . . *Cecidomyia* sp. p. 16
   Pitch nodules deep in bark, causing twig-stem to become swollen and scarred; all apical growth may be brown and dead . . . . . *Cecidomyia* sp. p. 15

8. (6) Fine irregular tunnels in and below the bark . . . . . *Pityophthorus* spp. p. 31
   Foliage and/or twig-stem surface damaged, small insects usually conspicuous 9

9. (8) Associated with smooth, flat, sessile scale insects 10
   No insects present or, if so, they are fluffy and/or mobile aphids 11

10. (9) Conspicuous elongate white scales with tiny elongate pale brown bodies; needles may be spotted yellow . . . . . *Phenacaspis pinifoliae* p. 28
    Smooth oval dark grey insects . . . . . *Nuculaspis californica* p. 28

11. (9) Foliage unevenly spotted yellow, sometimes densely so; needles possibly distorted and stunted; on the outer growth of young trees; usually associated with small woolly white aphids ..... *Pineus coloradensis* p. 29
Needles with chlorotic spots basally, twig-stems with small feeding scars; usually confined to the apex of young trees; shiny brown aphids usually present, or the remains of cast skins ..... *Cinara brevispinosa* p. 17

12. (2) Long straight tunnel down center of previous year's growth, often in the leader; circular exit hole may be present near lower end, approximately 2 mm diam; little frass, seldom any evidence of pitch, and no webbing ..... *Pissodes terminalis* p. 30
Otherwise, if tunnels present, then usually irregular, with pitch and/or webbing; exit holes irregular 13

13.(12) Only foliage damaged, no feeding damage on or in the twig-stem; no pitch 14
Feeding damage on twig surface, or shoot boring/ tunneling present; pitch often present 21

14.(13) Webbing absent or not apparent; foliage damage usually below twig tip 15
Webbing obviously present, usually on tip foliage 16

15.(14) Foliage usually eaten down to basal sheath; defoliation along sections of twig rather than on scattered needles ..... *Neodiprion* spp. p. 25
Leaves mined, mostly inside the sheath; webbing inconspicuous ..... *Coleotechnites* sp. p. 19

16.(14) Thick coarse web shelters matted with detritus and frass; tunnel-like and tapered, 1.5 - 14.0 cm long, or in thick irregular masses up to 25 cm diam; foliage conspicuously chewed; *Cephalcia* spp. 17
Webbing fine and irregular; if forming a shelter, then it is usually less than 1.5 cm long or free from detritus, or flat 18

17.(16) Massive compact web of frass around twig, accommodating up to 20 larvae; well below branch tip, usually on semi-mature trees ..... *C. californica* p. 16
Elongate web with one to several larvae, usually in the foliage near the branch tip; individual silk tunnels frequently apparent; usually on small trees ..... *Cephalcia* sp. p. 17

18.(16) Straight even cylindrical tubes of very fine pale webbing among the needles, but not incorporating them; seldom on the twig-stem or containing frass ..... *Zelleria haimbachi* (early instars) p. 33
Webbing irregular or, if a shelter is formed, it incorporates foliage and detritus 19

19.(18) Fine irregular webbing among the needle bases, incorporating some frass, and matting the many dead mined needles that have been severed within their sheaths ..... *Zelleria haimbachi* (concentrated population) p. 33
The webbing forming a definite shelter incorporating detritus or, if loosely irregular, then few mined needles present 20

20.(19) Irregular coarse stringy webbing through the foliage, with loosely clinging frass; foliage conspicuously damaged . . . . . *Choristoneura occidentalis* p. 17
A tunnel/shelter of fine dense webbing, incorporating detritus and frass, between needle bases and close to the twig; needles may be severed near their bases, but are not conspicuously damaged at mid-sections or tips . . . . . *Argyrotaenia citrana* p. 13

21.(13) From coastal B.C. 22
From interior B.C. 25

22.(21) Buds irregularly chewed and hollowed; two or three half-mined needles with webbing and frass nearby; seldom on candles . . . . . *Epinotia hopkinsana* p. 24
No half-mined needles present; buds more or less entirely hollowed; candle damage common 23

23.(22) Damage by small larvae (12 mm long); buds irregularly hollowed, candles often webbed together and eaten; evidence of pitch-web shelters; most likely from ornamental or stunted trees . . . . . *Rhyacionia buoliana* p. 31
Damage by larger larvae (18 mm); buds and candles hollowed paper-thin; little webbing or pitch; *Dioryctria* spp. 24

24.(23) Damage primarily to buds before candles are well developed; little frass or damaged foliage . . . . . *D. pentictonella vancouverella* p. 24
Damage primarily to candles, but buds and foliage also eaten; tunneling sometimes extending down into twig-stem; usually found on leaders . . . . . *D. abietivorella* p. 21

25.(21) Damage by small larvae (12 mm); buds irregularly hollowed; candles may be webbed together and eaten; pitch/silk larval shelters present, particularly during May-June; most likely from nursery, ornamental or stunted trees . . . . . *Rhyacionia buoliana* p. 31
Damage by larger larvae (18 mm); buds and/or candles often completely hollowed; usually on vigorous natural growth; *Dioryctria* spp. 26

26.(25) Damage mostly external—conspicuous webbing, pitch and detritus, often involving flowers and/or cones . . . . . *D. cambiicola* p. 22
Damage mostly boring—in buds and/or candles, seldom in flowers or cones 27

27.(26) Damage primarily to buds before candles are well developed; little frass or damaged foliage . . . . . *D. pentictonella pentictonella* p. 24
Damage primarily to candles, but buds and foliage also eaten; tunneling sometimes extending down into twig-stem, usually from leader . . . . . *D. abietivorella* p. 21

28. (1) No single tunnel down central twig-stem or candle; foliage not chewed, although possibly discolored; no hollow needles; no webbing 29
Otherwise, at least one of the above characteristics present 34

29.(28) Interior of (terminal) buds eaten 30
Damage to needles, twig-stem or candle 31

30.(29) February-April mining by small larvae (5 mm), usually in leaf buds . . . . . *Rhyacionia buoliana* (young instars) p. 31
May-June mining by larger larvae (10 - 20 mm) . . . . . *Dioryctria auranticella* p. 22

31.(29) Small pitch nodules on twig just below candles; foliage more or less evenly discolored and possibly flagged during summer months or later . . . . . *Cecidomyia* sp. p. 15
No pitch; foliage not evenly discolored 32

32.(31) Fine irregular tunnels in and below the bark . . . . . *Pityophthorus* spp. p. 31
No bark tunnels; foliage and/or twig surface damaged, leaves may be spotted yellow; small hard insects usually conspicuous 33

33.(32) Conspicuous elongate white shell-like scales, about 3 mm long, with tiny pale brown bodies . . . . . *Phenacaspis pinifoliae* p. 28
Associated with oval dark grey insects about 2 mm long . . . . . *Nuculaspis californica* p. 28

34.(28) Foliage chewed; seldom any pitch present 35
Foliage may be discolored and/or distorted, but seldom eaten or webbed; pitch frequently present 39

35.(34) Webbing present 36
No webbing, some areas of twig with needles eaten off nearly to bases . . . . . *Neodiprion* spp. p. 25

36.(35) Straight even cylindrical tubes of very fine pale webbing among the needles, but not incorporating them; seldom on the twig-stem or containing frass . . . . . *Zelleria haimbachi* (early instars) p. 33
Webbing irregular or, if a shelter is formed, it incorporates foliage and detritus 37

37.(36) Fine irregular webbing among the needle bases, incorporating some frass, and matting the many dead mined needles that have been severed within their sheaths . . . . . *Zelleria haimbachi* (concentrations of mature larvae) p. 33
The webbing forming a definite shelter incorporating detritus or, if loosely irregular, then few mined needles present 38

38.(37) A "shelter" of fine compact pale webbing along the twig, incorporating bits of foliage and usually developing upwards; insect about 10 mm long . . . . . *Argyrotaenia citrana* p. 13
Loose webbing among the needles, incorporating frass and chewed foliage, usually developing downwards; insect about 15 mm long . . . . . *Dioryctria auranticella* p. 22

39.(34) The vigorous new flushed shoots flagged, each with a regular tunnel down its center, usually with a small circular exit hole about 2/3 down the shoot; no apparent pitch or webbing . . . . . *Eucosma sonomana* p. 25
Damage to buds, candles and/or older growth; exit holes irregular; often with pitch and/or webbing 40

40.(39) Damage caused by relatively small larvae (12 mm) involving web-pitch feeding/pupal shelters among the buds and candles, usually in stunted trees or young ornamentals ..... *Rhyacionia buoliana* p. 31
Damage caused by larger larvae (18 mm), usually in mature trees; *Dioryctria* spp. 41

41.(40) Pitchy webbing between bases of buds, flowers, candles, cones, etc., incorporating considerable detritus ..... *D. cambiicola* p. 22
Mostly cone boring, complete excavation of buds or tunneling in shoots; little webbing, detritus or surface pitch 42

42.(41) Clean complete bud or shoot tunneling; usually on young trees .... *D. pentictonella pentictonella* p. 24
Irregular dirty tunneling in cones, occasionally in the buds or twig-stems; usually on mature trees ..... *D. auranticella* p. 22

DESCRIPTIONS OF SPECIES

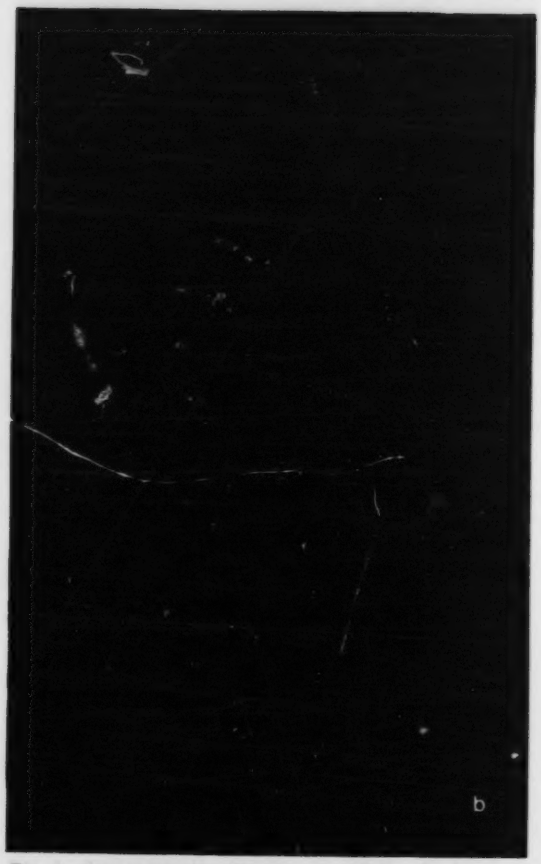


Fig. 1 *Argyrotaenia citrana:* a. adult. b. larva at feeding site.

Scale lines on photographs represent the actual size of the insect.

THE ORANGE TORTRIX

Argyrotaenia citrana (Fernald)
(Lepidoptera: Tortricidae)
[Figs. 1a, 1b]

DISTRIBUTION and HOSTS

This small leaf roller is common on Vancouver Island and in the lower Fraser Valley, and is also found in the northern interior. It feeds on all native species of pines, particularly *P. contorta,* and ornamental pines, and has a wide variety of hosts, e.g. *Abies, Chrysanthemum, Malus,* etc.

APPEARANCE

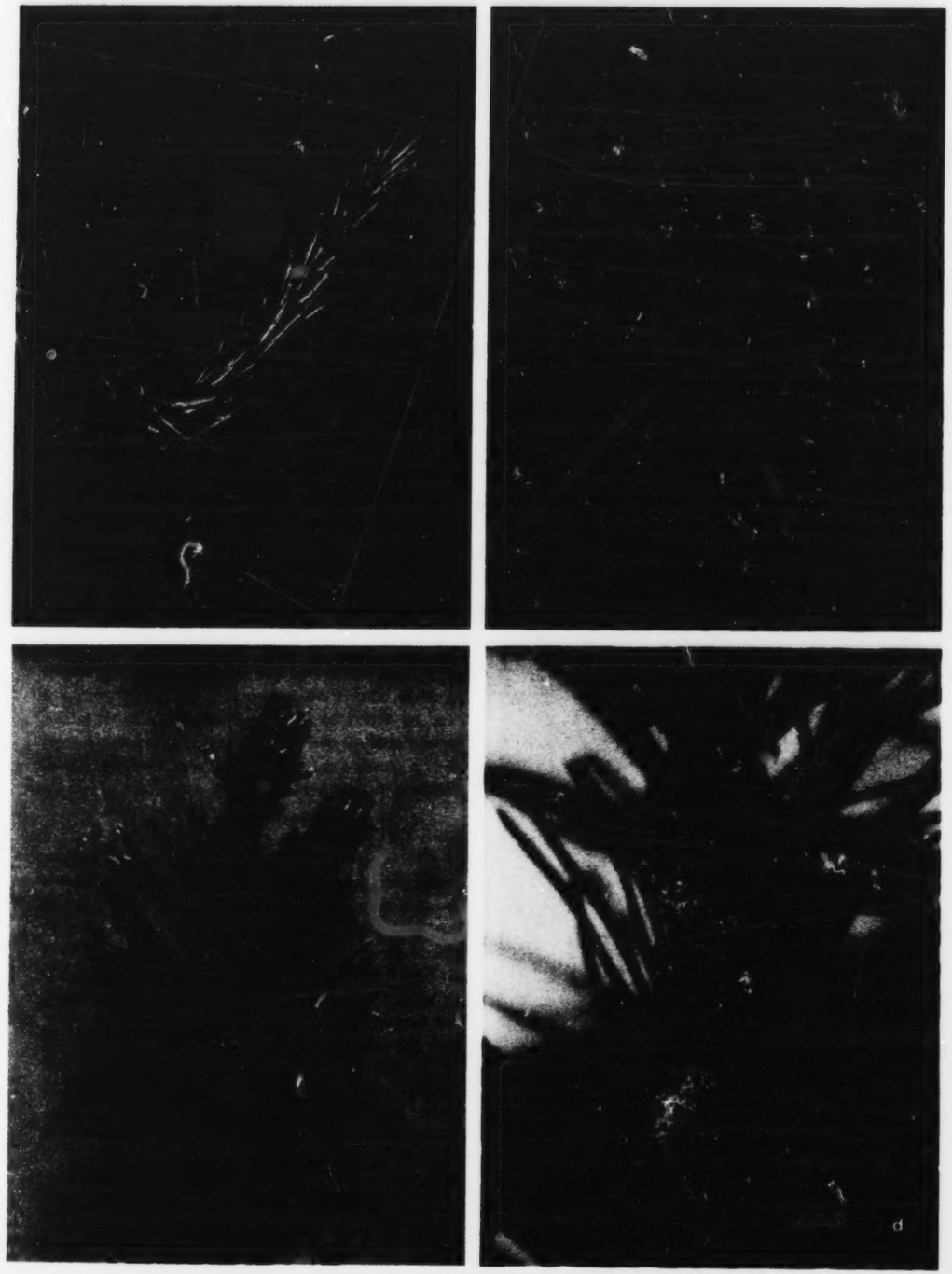
The adult has a wingspan of 14-19 mm and is typically tawny beige, shaded with dark grey markings: an angular basal area, an oblique diagonal band, and a sub-apical triangle along the front margin of the wing; rear wings are cream-colored. Specimens range in color from light orange to dark brown, and may be faded to a pale yellow. The slender active larva is about 9 mm long; variably shaded pale brown with a glossy light brown head and thoracic shield, and long, fine pale setae on light bases.

LIFE CYCLE

There is a wide seasonal range, and two or three generations can occur annually if conditions are favorable. Eggs are laid individually on the foliage but, under greenhouse environment, several may be placed on a single plant tip. The larva usually feeds on new foliage; the pupa may be at the feeding site or away from it. Where only one generation occurs, the overwintering stage is usually the young larva, and the greatest feeding is done on the new foliage during early summer of the following year. The pest is most commonly found in nursery or greenhouse stock. It may feed on trees of any age, but is more damaging to the younger ones.

DISTINGUISHING CHARACTERISTICS

Typical damage includes fine dense webbing among the bases of the new needles, with indiscriminate feeding, and tunneling in the terminal buds.



The latter damage resembles that caused by the European pine shoot moth (p. 31), but occurs earlier in the year, is less confined to the center of the bud, and has less pitch and webbing. Webbing by another pest, *Zelleria* (p. 33), is matted more closely to the twig-stem, with less visible feeding on the needles.

GALL MIDGES

Cecidomyia spp.
(Diptera: Cecidomyiidae)

These tiny flies are found on many hosts, but relatively few species are of economic importance; usually they cause small galls, and occasionally are associated with disease.

APPEARANCE

The fragile adults are approximately 2.5 mm long; the body is pale brown/pink/black, depending on species, age and sex; the wings are nearly clear. The ellipsoidal eggs change from pink to brown. Larvae and pupae, 2.5 mm long, become pink-orange as they mature; the latter develop a black thorax and head.

LIFE CYCLE

The species included here have similar life cycles: the adults live briefly during May-June when they lay eggs on the scales of the young shoots. The larvae overwinter in the plant tissue and complete their development early the following spring. Specific identification of adults is often difficult, but it is possible to separate some species by their characteristic plant distortion. The following four types of damage can be considered important in B.C.

◀ Fig. 2 *Cecidomyia* spp.: a. sharply bent shoot of ponderosa pine, with the white cocoon of the gall midge on the elbow (the spider webbing below is incidental). b. stunted shoots and dying foliage of ponderosa pine, caused by midge larvae in the twig; the scabrous resinosis and the dead buds of the previous year are typical. c. stunted and discolored terminal growth on shore pine, caused by *Cecidomyia* sp. larvae in the bark below the twig tip. d. wizened pitch-encrusted twig of shore pine, with cocoons of *Cecidomyia* sp. on the surface.

CROOKED SHOOTS

[Fig. 2a]

DISTRIBUTION and HOSTS

Such damage is found throughout B.C., most commonly in the south. It occurs particularly on *P. contorta*, frequently on *P. ponderosa*, and occasionally on *P. monticola*, and may be present on all age classes.

DISTINGUISHING CHARACTERISTICS

One to several larvae may be inside the lower ends of the needles at the shoot base, causing the shoot to curve to a varying degree in any direction, from which it has to reorient its growth. More than 40% of a tree may be affected. Shoot mortality is about 12%, and surviving growth may be temporarily distorted, weakened and attractive to other insects. Except for the distortion and the late summer discoloration of the nearby needles there are no other visible signs of damage.

TIP FLAGGING

[Fig. 2b]

DISTRIBUTION and HOST

Tip flagging occurs on *P. ponderosa* throughout its range, and is most common on young trees at lower altitudes.

DISTINGUISHING CHARACTERISTICS

The larvae feed in the bark of the previous year's growth, causing resinous blisters and often disrupting the sap flow sufficiently to flag and kill the shoot, which may persist on the tree for several seasons. Although as much as 60% of a tree may be affected, infestations generally are on scattered individual trees rather than throughout small stands (Silver and Ross 1961, p. 104). The damage is distinguishable from that of Lepidoptera and beetles by the presence of pitch pockets and the legless orange larvae, and by the absence of tunnels.

TWIG SWELLING

[Fig. 2c]

DISTRIBUTION and HOST

This damage can be found on young shore pines, frequently on leaders.

DISTINGUISHING CHARACTERISTICS

Small concentrations of larvae occur in pitch blisters in the bark of last year's growth, causing twig swelling, needle mortality and often the death of the shoot. Pupae are near the pitch surface. Infestations are generally found in reproduction stands and the principal injury is loss of the leader. The damage differs from that of the preceding species by the even swelling of the twig, which occurs before the terminal buds have had time to grow. The patch of evenly discolored needles is distinctive from the uneven spotty damage caused by aphids, and the absence of tunnels or defoliation distinguishes it from activities by boring beetles or Lepidoptera.

PITCH BLISTERS

[Fig. 2d]

DISTRIBUTION and HOST

Such damage occurs on shore pine, throughout the range of that tree.

DISTINGUISHING CHARACTERISTICS

One to several larvae may be found in scattered pitch blisters on the bark at the most recent twig nodes of the young trees. Considerable pitch flow is present; the larvae pupate outside the pitch, usually on its surface or on the needle bases. Shoots are stunted and sometimes killed; lateral budding commonly results. The damage is distinguishable from that of the preceding species by the superficial bark blisters and the copious pitch, found farther from the end of the twig and somewhat later in the season when the shoot is well expanded; also by the pupae outside the pitch. A different species on lodgepole pine causes less severe damage.

WEB-SPINNING SAWFLIES

Cephalcia spp.
(Hymenoptera: Pamphiliidae)

Several species of these defoliators are found in B.C., and those on conifers are more frequently noticed than those on deciduous trees.

DISTRIBUTION and LIFE CYCLE

The two species mentioned here both occur in southern B.C. and have similar life cycles: adults lay eggs in short rows on the pine needles during early summer; the larvae mature late August-September, then drop to the ground and burrow down several centimeters before overwintering in small dirt chambers; a brief pupal period occurs before the adults dig out during late June - early July of the following year. They are:

A PAMPHILIID

C. californica Middlekauff
[Fig. 3]

HOSTS

This insect has been found only on *P. contorta* in B.C., but in the United States occurs also on *P. ponderosa* (Middlekauff 1958, p. 135).

APPEARANCE

An adult is 10-17 mm long, with a thick body and massive head. The male is black with nearly clear wings; the larger female is shiny dark brown with an ochre head and thorax, and dark infuscated wings. An egg is approximately 3 mm long; smooth,

Fig. 3 *Cephalcia californica* larvae on their web/frass feeding shelter.

dark and slender, shaped like a canoe, and laid on the upper surface of a needle. The spiniform larva may grow to 26 mm in length; it is a dark apple-green, with two straight dark segmented spine-like appendages at each end.

DISTINGUISHING CHARACTERISTICS

Larvae are colonial, and as many as 25 may be found in a large irregular frass shelter, possibly 25 cm diameter, tunneled with webbing, amid the best foliage on the mid-section of a small branch. Several webs may be present, and the dense frass content is distinctive by the shape of the pellets, which are long, irregularly cylindrical and rough textured. The species seems to prefer semi-mature trees.

A PAMPHILIID

Cephalcia sp.

HOST

This web-spinning sawfly is found on young shore pine and sometimes occurs in sufficient numbers to stunt and kill the leaders.

DISTINGUISHING CHARACTERISTICS

The species is slightly smaller than *C. californica,* and the adults are paler in color. Larvae are brown, shaded green, orange or red, and tend to be gregarious in tubular shelters woven vertically between the needles, incorporating some foliage, and with more webbing and less frass than the preceding species. There are usually less than ten larvae in a web.

THE WESTERN SPRUCE BUDWORM

Choristoneura occidentalis Freeman
(Lepidoptera: Tortricidae)
[Figs. 4a, 4b, 4c]

DISTRIBUTION and HOSTS

This pest is common throughout southern B.C. (except the east) on *P. contorta* and on most other coniferous tree species, particularly Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco), but is rarely found on ponderosa or white pines (Silver and Ross 1965, p. 116).

APPEARANCE

The wingspan of an adult ranges from 15 to 30 mm, averaging 25 mm. The color varies from dark grey-brown to pale yellow-brown, the most common shades being ochreous. The complex wing pattern is comprised of three dark irregular diagonal bands, the second and third separated by a pale costal patch; rear wings are grey, usually with narrow lighter margins. The pale green eggs, each about 2 mm long and flattened-ovoid, are laid in shingle-like masses on the undersides of the needles. A larva may grow to 22 mm in length, and is dark brown with conspicuous black and white setal bases, two pairs on the upper part of each body segment; intersegmental areas are pale brown, and the ventral surface may be greenish; the head and thoracic shield are variably dark brown. The dark brown pupa is distinctively shaped, with a short plump thorax and a curved, finely tapered abdomen with its segments conspicuously annulated in both shape and color.

LIFE CYCLE

Egg masses vary considerably in size but usually contain 10-40 eggs. They are laid during mid-summer, and the dark larvae develop in about 10 days. They do not feed but seek individual shelter in nearby parts of the tree where they spin small webs for overwintering, and then moult into second instar. Feeding commences during mid-spring, in needles and/or buds, and as the larvae grow they construct webbing through the new foliage. Pupae are formed in the webbing during early summer, and adults emerge in about 2 weeks.

DISTINGUISHING CHARACTERISTICS

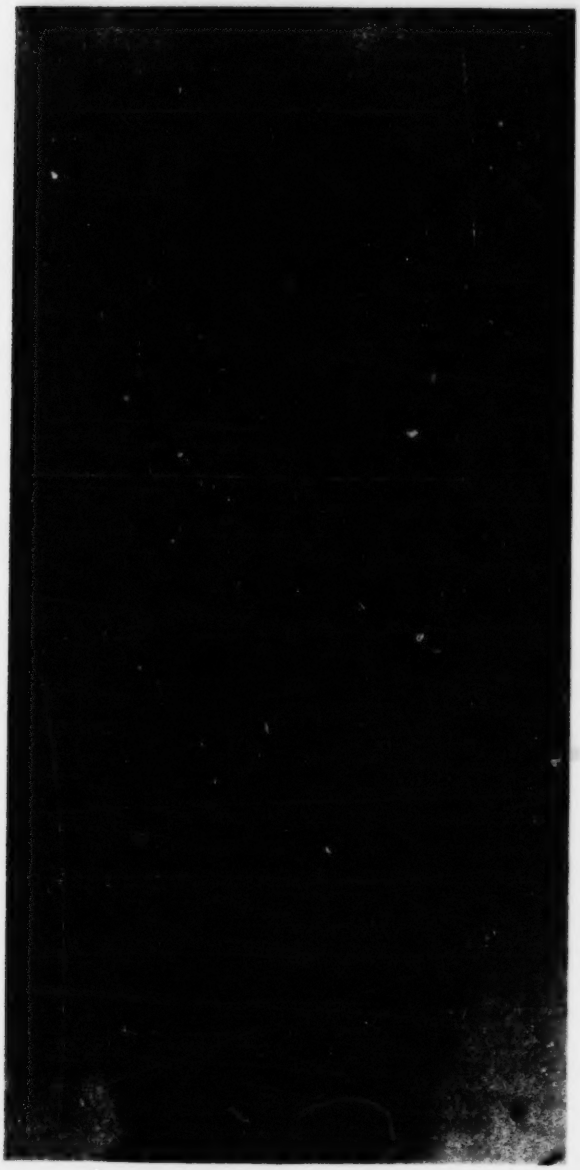
In addition to bud destruction, severe defoliation during heavy infestations may cause weakness, deformity, top-kill, etc., even mortality. Minor feeding resembles that of other web-shelter defoliators.

At least four other similar species of *Choristoneura* are present on B.C. conifers, but are not important on pines.

A PINE APHID

Cinara brevispinosa (Gillette and Palmer)
(Homoptera: Aphididae)
[Fig. 5]

Most large active aphids found on pines in B.C. are *Cinara,* and although some species may



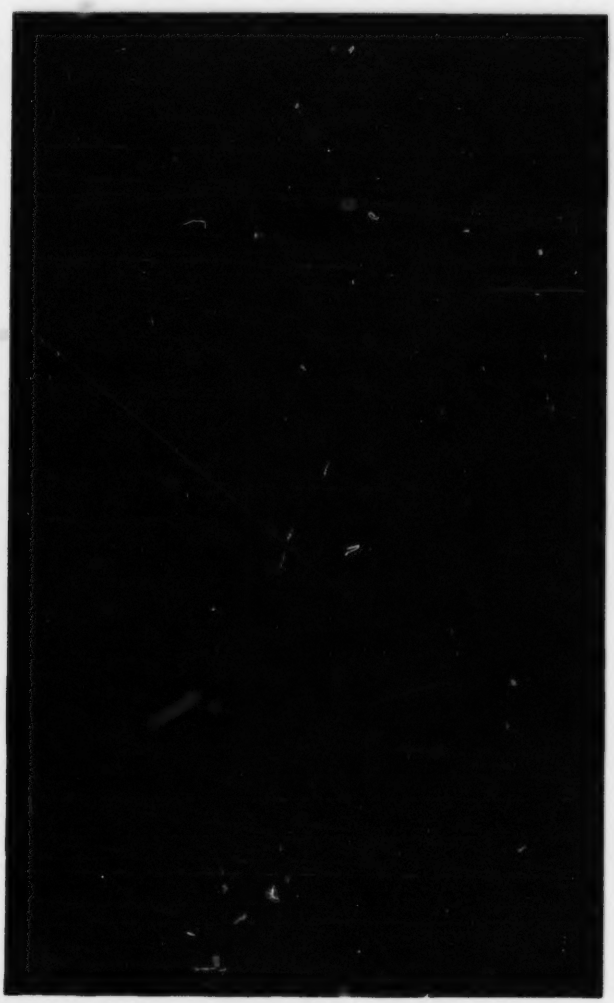


Fig. 4 *Choristoneura occidentalis:* a. adult. b. lodgepole pine tip damaged by one spruce budworm larva during 3rd-instar feeding. c. mature larvae on lodgepole pine.

Scale lines on photographs represent the actual size of the insect.

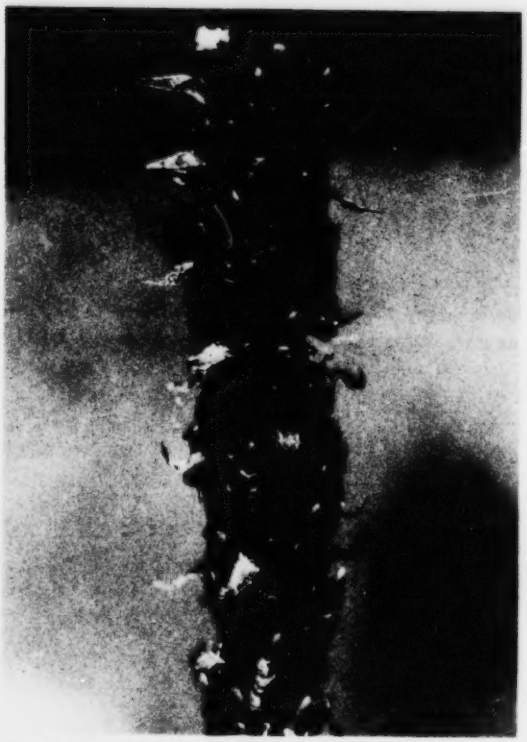


Fig. 5 *Cinara brevispinosa* nymphs clustered on terminal of lodgepole pine.

occur in large numbers (Furniss and Carolin 1977, pp. 95-96), *C. brevispinosa* is the only one believed to cause damage.

DISTRIBUTION and HOST

It has been found only on *P. contorta*, throughout most of the host range. Greatest populations occur in areas at medium land elevation.

APPEARANCE

The large dark-colored eggs are ellipsoidal, and are laid lengthwise on the needles, frequently in single (broken) rows; sometimes with traces of very fine pale webbing. The annual mid-spring generation is conspicuous when the shiny dark brown nymphs are actively clustered on the pine terminals, particularly on the leaders of young trees. They are most numerous on the expanding candles and the growth immediately below, where they feed on the twig-stem rather than on the foliage. Colonies usually have a wide size range of nymphs, and adults are often present; more than one generation may occur in a season. Overwintering normally is in the egg stage. Tree shoots may be stunted, deformed or possibly killed.

DISTINGUISHING CHARACTERISTICS

Damage can usually be identified by the presence of cast skins on the plant and the feeding punctures on the new twigs. The distinctively shiny aphids have legs longer than their bodies.

C. medispinosa (Gillette and Palmer) is common throughout B.C., and may be found on all native *Pinus*. It is smaller than *C. brevispinosa*, slightly grey, and somewhat less colonial. *C. ponderosae* (Williams) is similar in habit and appearance to *C. brevispinosa*, but less abundant; it is frequently found on *P. ponderosa*, usually in late June, and may also occur on introduced species of pines.

A NEEDLE MINER

Coleotechnites sp.
(Lepidoptera: Gelechiidae)
[Figs. 6a, 6b]

DISTRIBUTION and HOST

This pest is found on shore pine along the coast.

APPEARANCE

The slender grey-brown adult has a wingspan of about 9.5 mm. The larva is about 5 mm long; bright leaf-green with the thoracic and anal shields and the head black; it has long pale body hairs on small dark bases.

LIFE CYCLE

An egg hatches a few days after it is laid and the small larva overwinters in the shelter of a bud. It begins mining the inside of a needle base in the expanding foliage late the following spring. Each larva partially mines several needles at sheath level so that much of the tip foliage dies, and twigs may be stunted and killed. The pupa is formed inside the needle sheath. The insect has been found only on saplings and semi-mature trees.

DISTINGUISHING CHARACTERISTICS

The larva is distinctive by its green color. Although frass is extruded into the needle sheaths there is little webbing, and the exit holes are irregular, which distinguishes the damage from that of *Zelleria* (p. 33) and some other species of *Coleotechnites* (p. 39).

Fig. 6 *Coleotechnites* sp.: a. adult. b. damage to shore pine.

Fig. 7 *Conophthorus monticolae:* a. adult, showing the hairy appearance. b. mature larva in feeding gallery at base of conelet.

A PINE CONE BEETLE

Conophthorus monticolae Hopkins
(Coleoptera: Scolytidae)
[Figs. 7a, 7b]

DISTRIBUTION and HOSTS

This species occurs throughout southern B.C. in the cones and buds of *P. contorta* and *P. monticola,* also on exotic species.

APPEARANCE

The stout adult beetle is about 3.5 mm long; shiny dark brown with the pronotum often darker; it is superficially distinctive by its broad even contour and allover conspicuous pubescence. The larva is a legless white grub with a pale brown head and inconspicuous setae.

LIFE CYCLE

Although *C. monticolae* is primarily a pest of cones (Hedlin 1974, p. 35), it also destroys twig tips and leaf and flower buds. The adult bores egg galleries during the spring and the larva feeds until midsummer; then there is a short pupal period. The adult overwinters in the fallen cone, although in coastal B.C. it may move to any convenient shelter.

DISTINGUISHING CHARACTERISTICS

Feeding galleries of *C. monticolae* are webfree irregular cavities rather than tunnels and this, combined with the size of the mature larva, distinguishes the damage from that of other scolytids and Lepidoptera; the larva is relatively stouter and hairless in contrast to a young anobiid beetle which has much the same habits (p. 40).

SHOOT BORERS, CONEWORMS, PITCHWORMS

Dioryctria spp.
(Lepidoptera: Pyralidae)

Several *Dioryctria* species in B.C. feed on pines, and four of them may cause shoot damage.

APPEARANCE

The moths have the narrow forewings typical of the family, further characterized by dark-edged pale zigzag anterior and posterior diagonal lines; wingspans range from 21 to 34 mm. A mature larva is about 20 mm long, of stout even form appearing slightly flattened, relatively untapered but distinctly segmented; it is dark or pinkish-brown with little pattern except for the shaded head, paler intersegments and contrasting setal bases; a young larva is sometimes paler and may appear banded. The pupa is slender. There is one generation annually, usually overwintering as an egg or young larva, sometimes as a prepupal larva.

DISTINGUISHING CHARACTERISTICS

Young *Dioryctria* larvae may be mistaken for those of the European pine shoot moth (p. 31) but have more conspicuous setae, attain a larger size and are more solitary. Their darker color separates them from pitch moth larvae (p. 48) which occasionally are found in shoots. Tunnels in the shoots are much larger and more irregular than tunnels by *Eucosma* or *Pissodes*. The four significant pine species here are:

A SHOOT BORER

D. abietivorella (Grote)
[Fig. 8]

DISTRIBUTION and HOSTS

This pyralid is found throughout B.C. on all native species of pines, most commonly on *P. contorta;* it is also found on exotic pines, Douglas-fir, Sitka spruce (*Picea sitchensis* (Bong.) Carr.), and probably on some other conifers.

APPEARANCE

The grey forewings of the adult have no raised scales; the translucent rear wings are nearly white, with fine dark veins and margins, often with a paler sub-marginal band. The larva is pink-brown and may be pale with inconspicuous setal bases and pale brown head, or dark with black setal bases and a near-black head.

Fig. 8 *Dioryctria abietivorella:* lodgepole pine leader destroyed by larval boring; the mature larva is on the extruded frass on the lower stem.

DISTINGUISHING CHARACTERISTICS

The most common form of damage on pine is the clean and complete hollowing of the terminal buds early in the spring. Other damage may be the tunneling of leaders, cones or bark, with accompanying defoliation; pitch or conspicuous webbing are rarely present. Occasionally *D. abietivorella* is found in rust cankers. The pupal shelter is often formed away from the original feeding site.

Fig. 9 *Dioryctria auranticella:* a. adult. b. larva, and its damage to a young ponderosa pine shoot.

A CONEWORM

D. auranticella (Grote)
[Figs. 9a, 9b]

DISTRIBUTION and HOST

This species is limited to the southern interior of B.C. on *P. ponderosa.*

APPEARANCE

The adult is orange-brown with irregular pale lines on the forewings and shaded pale rear wings. The larva is monocolor dark brown-grey with a brown-shaded head, a darker thoracic shield and small dark setal bases.

DISTINGUISHING CHARACTERISTICS

This insect is primarily a cone borer (Hedlin 1974, p. 38), developing entirely in one cone, but it also tunnels in buds and candles, mostly on mature trees. Some webbing is usually present, seldom any pitch. Larvae not feeding in cones usually pupate in the foliage, well away from the feeding site. The damage differs from that of web-spinning sawflies by the flatter, more open webbing nearer the twig, the feeding on the twig, and the scattered dark chunky frass.

A PITCHWORM

D. cambiicola (Dyar)
[Figs. 10a, 10b, 10c]

DISTRIBUTION and HOSTS

Commonly found only on mature *P. ponderosa* in interior B.C., *D. cambiicola* occurs occasionally on *P. contorta,* but rarely in coastal areas, where other hosts are preferred.

APPEARANCE

The moth is dark grey with brown shading; forewings have a sub-basal band of raised black scales; the rear wings are allover pale grey, shaded dark brown. The larva is light grey-brown with conspicuous large dark setal bases, a light brown head, and a dark thoracic shield paler at the mid-section.

DISTINGUISHING CHARACTERISTICS

The typical feeding site is an untidy mass of webbed pitch near the twig tip, often incorporating flowers and foliage; the tip is usually killed (Mutuura, Munroe and Ross 1969, p. 1012). Sometimes feeding is limited to cone or twig tunneling. Pupation is in the shelter. Damage often seems confined to individual trees, and may be recurrent.

Fig. 10 *Dioryctria cambiicola*: a. adult. b. larva in young shoot of ponderosa pine. c. larval feeding site on ponderosa pine with pitch blister and dead twig tip.

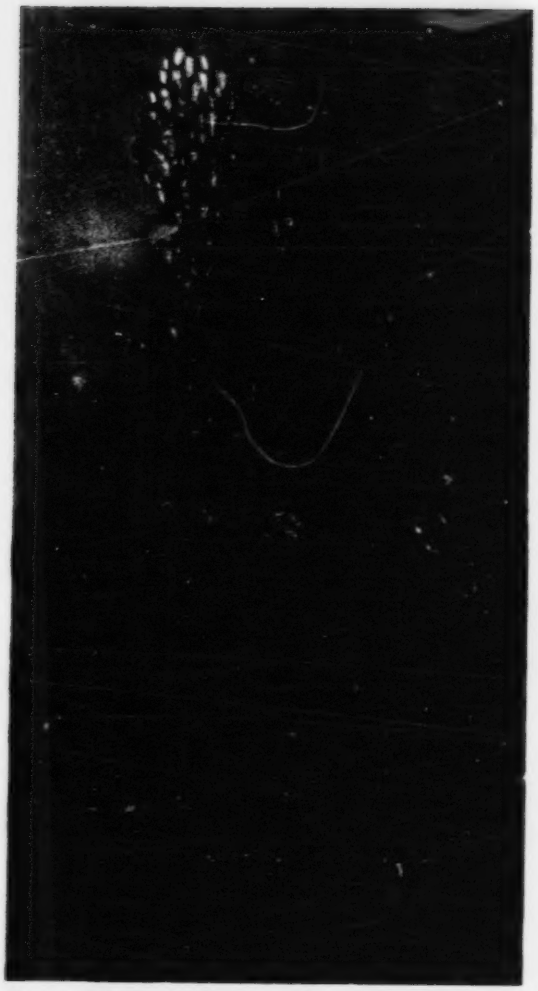


Fig. 11 *Dioryctria pentictonella vancouverella:* terminal bud on shore pine killed by boring larva.

A SHOOT BORER

D. pentictonella Mutuura, Munroe and Ross
[Fig. 11]

DISTRIBUTION and HOSTS

This borer is distributed throughout southern B.C. on lodgepole and ponderosa pines, and is also on introduced pines.

APPEARANCE

Contrasted to *D. cambiicola,* the adult is slightly smaller, more grey and less brown, with paler rear wings that commonly have a lighter sub-marginal band. The larva is dark brown with inconspicuous pale setal bases, a near-black head, and a darker thoracic shield. It bores through buds, candles or leaders, producing little webbing or pitch. The insect seems to prefer young trees and damage is often localized (Mutuura, Munroe and Ross 1969, p. 1044). *D. p. pentictonella* occurs in the interior and the coastal subspecies is *D. p. vancouverella* Mutuura, Munroe and Ross.

A TIP BORER

Epinotia hopkinsana (Kearfott)
(Lepidoptera: Olethreutidae)
[Figs. 12a, 12b]

DISTRIBUTION and HOSTS

This common borer is found along the coastal region of B.C. on Sitka spruce, shore pine, Douglas-fir, exotic pines, and likely on other conifers.

APPEARANCE

The moth has a wingspan of 13-19 mm; the sub-angular forewings vary from light grey to brown-grey, often greenish, finely marked with indistinct darker zigzag shading; rear wings are grey, slightly darker apically. A mature larva is about 9 mm long and relatively fat; typically a pale grey-green-brown, or sometimes nearly white or dark brown, with prominent large dark setal bases; the head and thoracic shield are yellow-brown, the latter dark-margined.

LIFE CYCLE

Oviposition is on new buds during midsummer. The young larva overwinters, usually inside a needle, and does most of its feeding early the following spring. Some needles are mined, some are webbed together with conspicuous pale frass, and late feeding may include bud and conelet hollowing, and stem or candle boring. Larvae are usually solitary. Pitch may be present, but during the heavy feeding period frass is often absent from the feeding site. Pupation occurs in a tight web shelter in the feeding cavity. Individual trees, particularly isolated ornamentals, may sustain considerable terminal damage; very young trees are seldom utilized.

DISTINGUISHING CHARACTERISTICS

The larval coloration is distinctive, as is the needle mining; two or three needles are completely hollowed, with relatively large circular exit holes and conspicuous webbing and pale frass.

Fig. 12 *Epinotia hopkinsana:* a. adult. b. mature larva at typical feeding site on shore pine; an exit hole from a mined needle is visible at lower right.

A SHOOT BORER

Eucosma sonomana Kearfott
(Lepidoptera: Olethreutidae)
[Figs. 13a, 13b, 13c]

DISTRIBUTION and HOSTS

This distinctive pest is found in southern B.C., including Vancouver Island, principally on ponderosa pine, sometimes on *P. contorta.*

APPEARANCE

The moth has a 13-20 mm wingspan. Forewings are shaded rich brown with two dark silvery-grey irregular diagonal bands; rear wings are dark silvery-grey; the head is cream-colored. The larva is about 13 mm long, nearly white except for the brown head and small thoracic shield.

LIFE CYCLE

The adult emerges mid-spring and lays eggs singly on the swelling buds. The larva bores down the center of the expanding shoot, creating a relatively clear tunnel about 13 cm long. At maturity, usually in mid-June, the larva leaves the shoot from a circular hole about 15 mm above the lower end of the tunnel, and pupates beneath the ground litter to overwinter as a pupa.

DISTINGUISHING CHARACTERISTICS

Infested shoots become droopy and do not attain full growth. The damaged terminals are stunted, if not broken or killed, which results in distorted trees and loss of increment. Curled dead shoots may persist for several months. Open growing saplings seem most attractive to the insect, and localized trees may be 40% infested (Grant 1958). The damage differs from that of most other pine shoot borers in that the tunnels are long, clear and centered in the current growth, and are much smaller than those of *Dioryctria* spp.

SAWFLIES

Neodiprion spp.
(Hymenoptera: Diprionidae)
[Figs. 14a, 14b, 14c]

Several species of these conifer-feeders are found throughout B.C. but, of those found on pine, only one is important.

Scale lines on photographs represent the actual size of the insect.

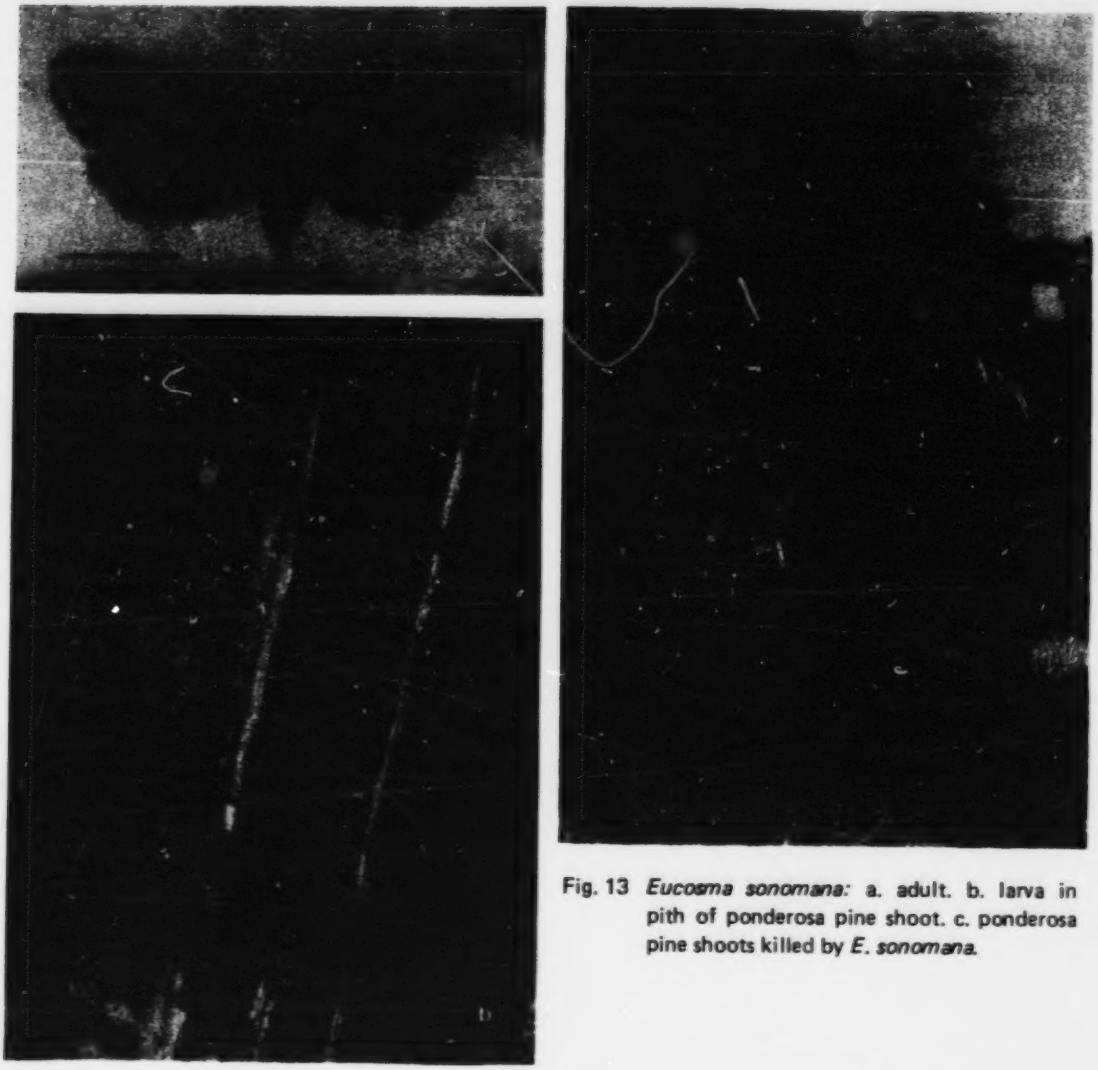


Fig. 13 *Eucosma sonomana:* a. adult. b. larva in pith of ponderosa pine shoot. c. ponderosa pine shoots killed by *E. sonomana.*

APPEARANCE

The thick-bodied adults, about 6 mm long, are characterized by their sex differences: males are mostly black, with conspicuously feathered antennae; the less active females are larger and more robust, shaded brown, with simple thick antennae. Eggs are laid during the autumn in series of individual crescent-shaped slits in the needle margins. A mature larva is about 15 mm long; the smooth body is humped anteriorly and tapered posteriorly, with seven pairs of abdominal prolegs; usually it has a shiny black head and shaded green stripes, but colors vary greatly with age and sex. During this stage it is usually colonial. The larva spins a tough silvery-grey-brown elliptical cocoon near the feeding site or in the ground litter.

LIFE CYCLE

The adult may emerge in the autumn and lay overwintering eggs, or the larva may overwinter in the cocoon; prepupal diapause is common.

DISTINGUISHING CHARACTERISTICS

Feeding damage is limited ordinarily to old foliage, and is distinct from that of most defoliators by the completely removed needles and the absence of webbing and frass.

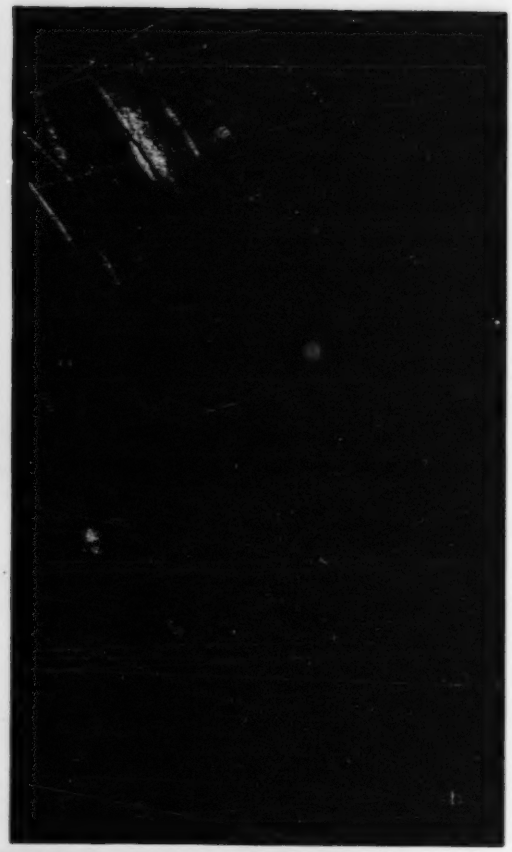
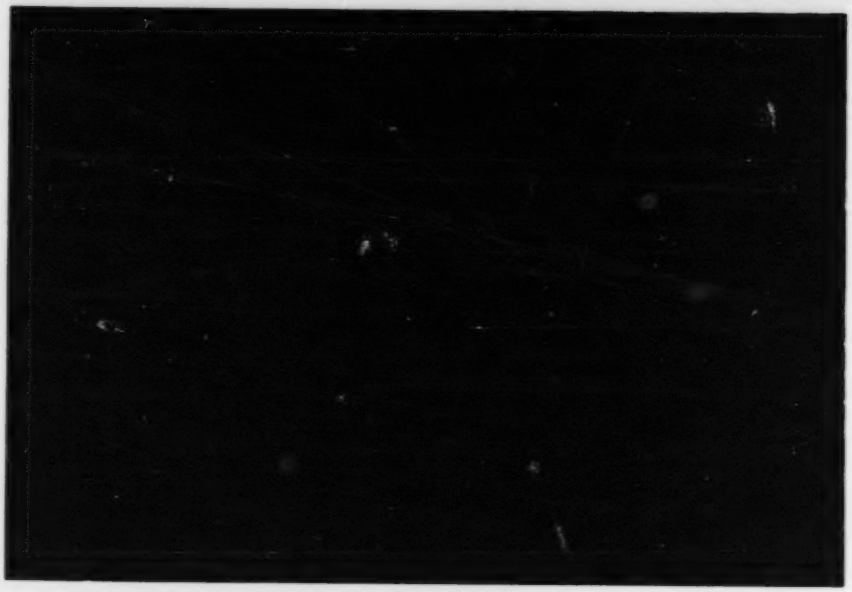


Fig. 14 *Neodiprion* spp.: a. adults: the male is smaller, with feathery antennae. b. eggs inserted in the margins of ponderosa pine needles. c. larval colony feeding on shore pine.



A PINE SAWFLY
N. nanulus contortae Ross

DISTRIBUTION and HOSTS

This particular species occurs in interior B.C. on all *Pinus* spp., but most commonly on *P. ponderosa*. A fully grown larva may be 20 mm long, and is slightly paler than most other species, often with a light brown head. A colony may contain up to 90 larvae. The cocoon is usually in the ground litter. Winter is passed as an egg or a prepupal larva.

A smaller darker species found on coastal pines may also occur on other hosts. Its populations are more localized and concentrated than *N. n. contortae* (Tripp, Ross and Van Sickle 1976).

THE BLACK PINELEAF SCALE
Nuculaspis californica (Coleman)
(Homoptera: Coccidae)
[Fig. 15]

DISTRIBUTION and HOSTS

This black scale is most common in the southern interior on ponderosa pine, but is also frequent on lodgepole pine.

APPEARANCE

A mature scale is nearly 2 mm long: a low, dark grey cone, like a limpet shell, oval in outline; the young scale is pale brown and slender. The insect adheres to the surface of the needle or twig; the concentration of insects may be sparse or dense. Very young scales, in the spring, are mobile and wind-dispersed. There may be more than one annual generation under favorable conditions. Trees of any age are susceptible, and severe infestations can kill the host (Furniss and Carolin 1977, pp. 117-118).

THE PINE NEEDLE SCALE
Phenacaspis pinifoliae (Fitch)*
(Homoptera: Coccidae)
[Figs. 16a, 16b]

DISTRIBUTION and HOSTS

This common and conspicuous pest is abundant on *P. ponderosa*, but occurs throughout the province on other species of pines and also on other conifers: spruces, Douglas-fir, western red cedar (*Thuja plicata* Donn), etc.

APPEARANCE

The young pale brown scales, less than 1 mm long, may go unnoticed, but the mature insects are

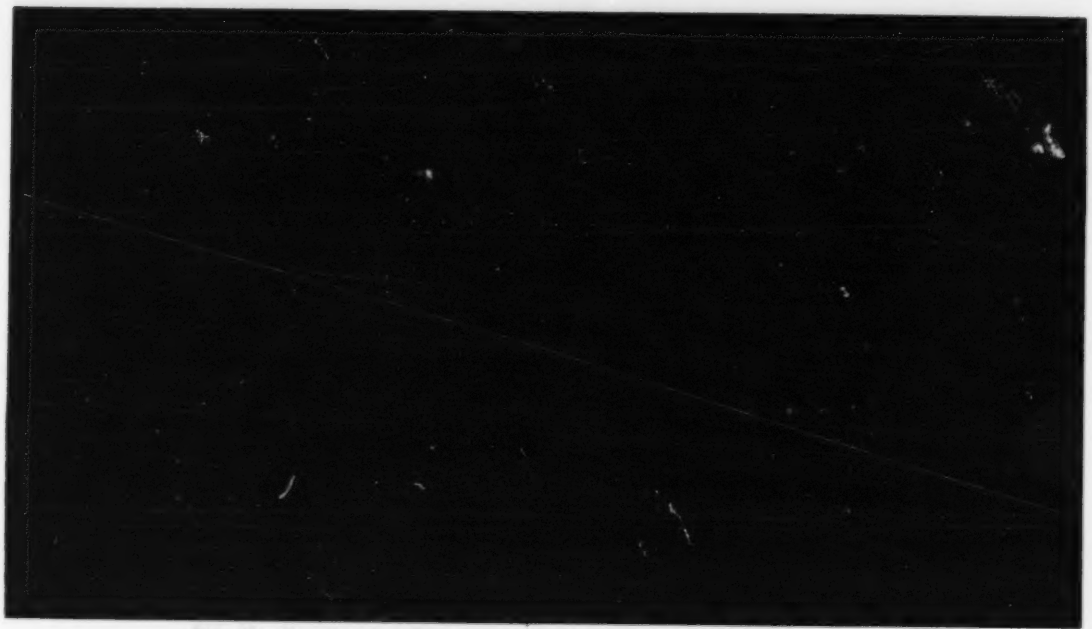


Fig. 15 *Nuculaspis californica*: mature scales on a ponderosa pine needle.

*Now *Chionaspis pinifoliae*

Fig. 16 *Phenacaspis pinifoliae*: a. ponderosa pines affected by *Phenacaspis*. b. a tip of ponderosa pine infested by pine needle scales.

conspicuous by their flat, narrow, smooth white shells, about 3 mm long; foliage and/or stems may be covered with them. The needles become spotted and yellow before they die.

LIFE CYCLE

After overwintering under the body of the female, the eggs hatch into briefly mobile nymphs during the spring; ordinarily there is only one generation a year. Sustained heavy infestations may cause tree mortality (Furniss and Carolin 1977, pp. 115-116).

DISTINGUISHING CHARACTERISTICS

The smooth white elongate shape distinguishes this scale from most other insects likely to be found on pine.

A WOOLLY APHID

Pineus coloradensis (Gillette)
(Homoptera: Adelgidae)
[Fig. 17]

DISTRIBUTION and HOSTS

This species complex is most common in the interior on lodgepole pine, but it also occurs on white, ponderosa and shore pines.

APPEARANCE

The abundant cottony nymphs shelter under the expanding foliage, and develop waxy colonies along the twigs; in such areas, and immediately below them, dark sooty molds grow on the insect exudate. Heavy infestations may adversely

Fig. 17 *Pineus coloradensis* nymphs on shore pine.

affect tree growth, particularly on young trees. Other species of *Pineus* are common on pines, and other conifers may host both *Pineus* spp. and those of the related genus *Adelges*. The "woolly aphids" are distinctive in appearance from most other pests.

THE LODGEPOLE TERMINAL WEEVIL

Pissodes terminalis Hopping
(Coleoptera: Curculionidae)
[Figs. 18a, 18b]

DISTRIBUTION and HOSTS

This snout beetle is found on *P. contorta* throughout the range of that tree, and occasionally on *P. monticola.*

APPEARANCE

An adult is 4-8 mm long, dark brown shaded ochre and grey. The legless larva is about 8 mm long; white with a light brown head and small thoracic shield.

Fig. 18 *Pissodes terminalis:* a. adult. b. lodgepole pine leader cut open to show larva in tunnel.

LIFE CYCLE

Eggs are laid during mid-summer in small individual excavations near the terminal tips, and hatch within 2 weeks. Some larvae develop to pupae for overwintering, but many feed until late the following spring, at that time tunneling out the inside of a leader for as much as 20 cm; occasionally lateral terminals are utilized. The tunnel is loosely filled with curled shavings; more than one larva may be in the

same stem. Individual exit holes are made by the emerging adults. Buds on currently infested terminals seldom reach more than a few centimeters in length, growth becomes stunted and the terminals become brown and die (Molnar *et al.* 1969, p. 116).

DISTINGUISHING CHARACTERISTICS

The adult weevil resembles other *Pissodes* species but the damage it does differs from that of most other beetles by the relatively large straight single tunnel through the wood of the terminal, and from lepidopterous mining by the presence of fine shavings.

SMALL TWIG BEETLES

Pityophthorus spp.
(Coleoptera: Scolytidae)
[Figs. 19a, 19b]

More than a dozen species of *Pityophthorus* are found in B.C. but only two are considered important: *P. confertus* Swaine and *P. confinis* Leconte.

DISTRIBUTION and HOSTS

P. confinis, approximately 3.0 mm long, occurs mostly in ponderosa pine; whereas *P. confertus* is somewhat smaller, averaging 2.2 mm in length, and occurs in all species of B.C. pines, most commonly in *P. contorta.*

APPEARANCE

The shiny dark brown beetles are narrow and cylindrical, with evenly tapered pronotums and slightly flattened posteriors. They may infest buds, twigs, branches or stems, most often near the tops of mature trees, either living or dead; they may be primary or secondary pests.

LIFE CYCLE

Infested twigs may contain any number of larvae, boring short irregular galleries under the bark and through the wood. Adults may occur throughout the summer and there may be more than one annual generation; overwintering can be in either the larval or adult stage. Living twigs are weakened and usually killed; severe infestations may kill tree tops or young trees.

Three other common species are *P. borealis* Swaine on *P. contorta* throughout B.C., *P. opimus* Blackman on *P. contorta* in northern B.C., and *P. (Myleborus) boycei* Swaine in lodgepole twigs.

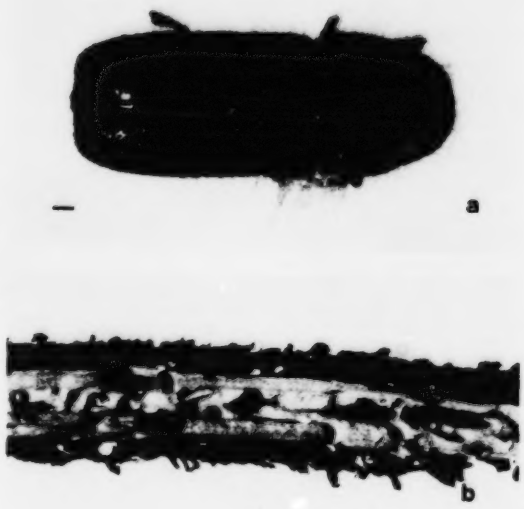


Fig. 19 *Pityophthorus* spp.: a. *P. confertus* adult. b. a section of ponderosa pine twig with larval boring by *P. confinis.*

THE EUROPEAN PINE SHOOT MOTH

Rhyacionia buoliana (Schiffermueller)
(Lepidoptera: Olethreutidae)
[Figs. 20a, 20b, 20c]

DISTRIBUTION and HOSTS

The European pine shoot moth first appeared in western North America in B.C., in 1925, and has since become established on southeastern Vancouver Island and in the lower Fraser Valley. Since 1960 it has been found at various locations in the southern interior of the province. It is primarily a pest of hard pines, and plantation and ornamental trees are particularly susceptible (Silver 1964). The insect has been widely distributed in nursery stock. *P. contorta* and *P. ponderosa* may be severely infested under managed environment, and there have been occasional records of the pest on naturally grown *P. ponderosa.*

APPEARANCE

The adult has a wingspan of about 17 mm; forewings are bright ochre in color, with shaded cream-colored linear and diagonal markings; rear wings are dark grey; the head is conspicuously pale. The chubby larva may reach 16 mm in length, and is

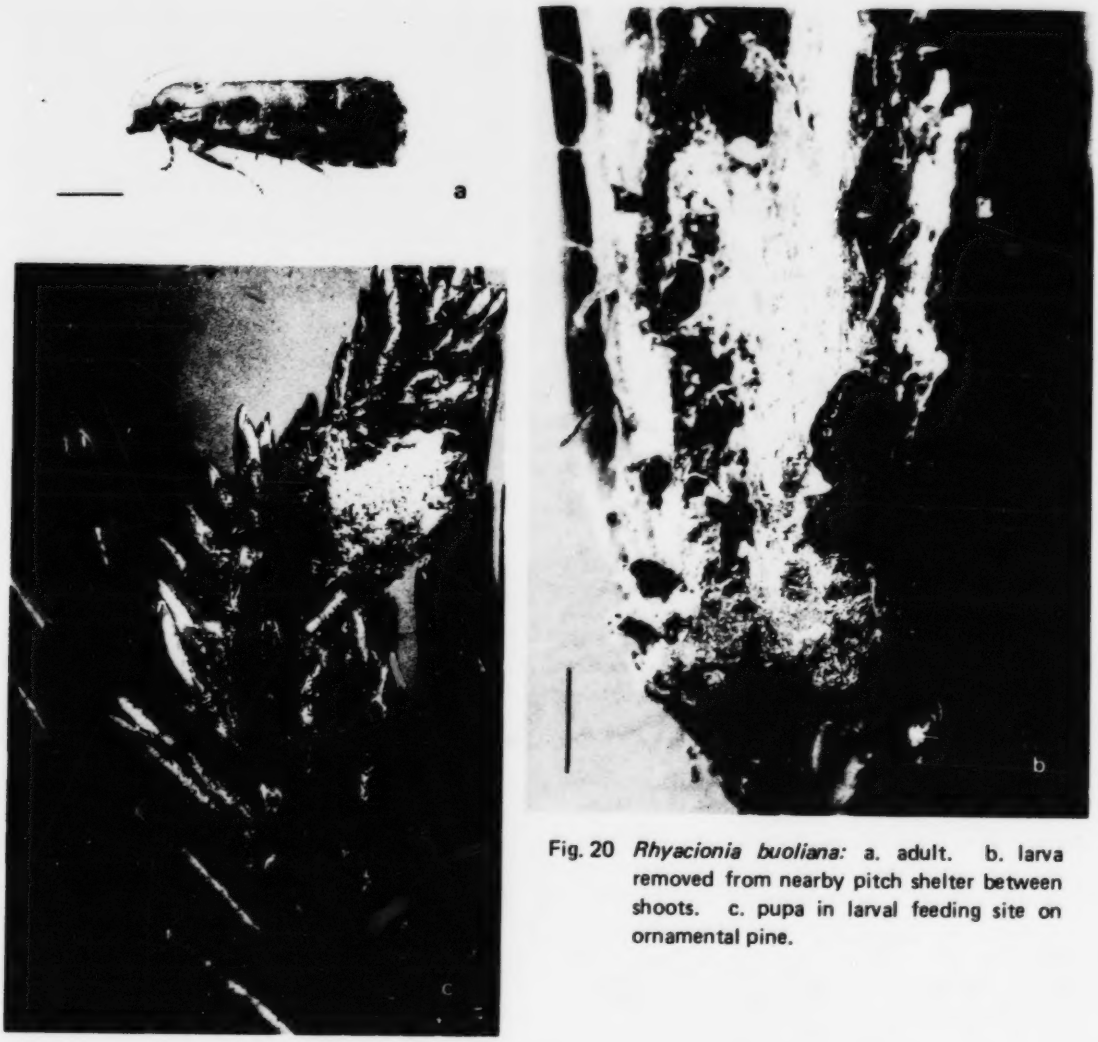


Fig. 20 *Rhyacionia buoliana:* a. adult. b. larva removed from nearby pitch shelter between shoots. c. pupa in larval feeding site on ornamental pine.

smooth monocolor dark brown with a shiny black head and thoracic shield; early-instar larvae and prepupal larvae have bodies that are less dark. The dark brown pupa is characterized by a bluntly tapered decurved abdomen.

LIFE CYCLE

Single eggs are laid near the bases of terminal needles in late June or early July, and hatch in approximately 12 days. A larva mines into nearby needles, but soon moves into a bud for the winter, feeding there occasionally as temperature permits. Most of the feeding is done April-May, when buds and candles are tunneled. The final feeding web/pitch-shelter at the bud base, or between touching shoots, is also the pupal chamber. Pupation takes place about late May, and the adult emerges during June (sometimes earlier). Infested buds usually die, and as infestations become more concentrated the tree growth is severely affected, and young trees are sometimes killed. The insect is generally limited, above the snow blanket, by a minimum temperature of $-29^{\circ}C$ ($-20^{\circ}F$), and temperature-humidity and tree growth factors are important in its development.

DISTINGUISHING CHARACTERISTICS

The larvae and damage may easily be confused with species of *Epinotia* and *Dioryctria,* but the form and color of a larva are reasonably distinctive (see larval key).

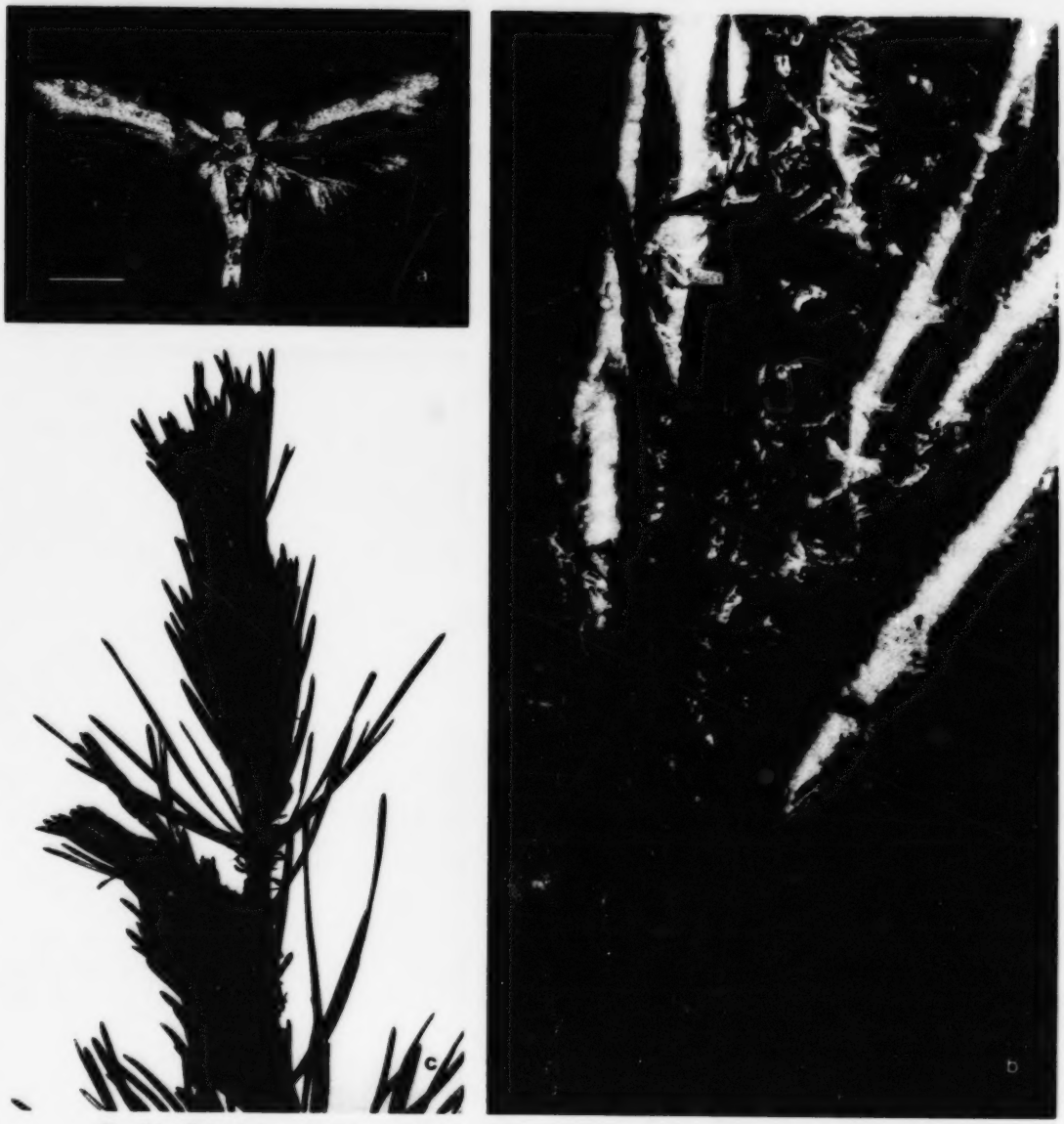


Fig. 21 *Zelleria haimbachi:* a. adult. b. mature larva. c. feeding damage on lodgepole pine.

THE PINE NEEDLE SHEATHMINER

Zelleria haimbachi Busck
(Lepidoptera: Yponomeutidae)
[Figs. 21a, 21b, 21c]

DISTRIBUTION and HOSTS

Z. haimbachi is common throughout southern B.C. on *P. contorta* and *P. ponderosa,* and occasionally on other species of pine.

APPEARANCE

The slender light brown moth has lanceolate wings with a span of about 11 mm; forewings have a wide silvery-white median streak; rear wings are very pale silvery-brown. The larva is about 10 mm long, very slender with a relatively small head; smooth, apparently hairless, and evenly shaded ochre-brown; it can wriggle rapidly. The light brown pupa is also slender.

LIFE CYCLE

The adult emerges during late summer and eggs are laid singly, or in twos and threes, on the terminal foliage. The larva develops in a few days and bores into a needle, where it overwinters, seldom feeding. The following spring it comes out of the needle and moves along the foliage fascicles through a fine web tunnel, chewing the needles off at sheath level. A heavy population may destroy much of the foliage and possibly kill the twigs (Tripp, Ross and Van Sickle 1976, p. 80). The pupa is webbed into a foliage shelter, and develops for about 3 weeks through July.

DISTINGUISHING CHARACTERISTICS

The fine gauzy cylindrical white larval tunnel is distinctive, as is the matted appearance of the severed dead foliage in infestations.

COMMON INSECTS OF LIMITED LOCAL SIGNIFICANCE

DESCRIPTIONS OF SPECIES

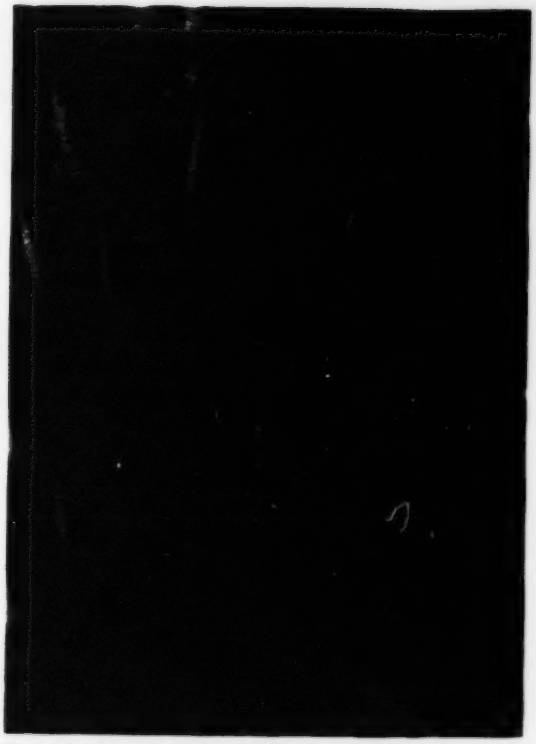


Fig. 22 *Acantholyda verticalis:* a mature larva on lodgepole pine.

WEB-SPINNING SAWFLIES

Acantholyda brunnicans (Norton)
A. verticalis (Cresson)
(Hymenoptera: Pamphiliidae)
[Fig. 22]

DISTRIBUTION and HOSTS

These two pamphiliids are found on all species of native pines in B.C., although *A. verticalis* is seldom found at the coast. *A. brunnicans* has also been found on Engelmann spruce (*Picea engelmannii* Parry), white spruce (*P. glauca* (Moench) Voss), and some exotic pines. Many other species of *Acantholyda* are found on conifers, and some on deciduous trees (Middlekauff 1958).

APPEARANCE and LIFE CYCLE

The life cycle and general appearance is similar to *Cephalcia* (p. 16). *Acantholyda* adults are usually smaller than *Cephalcia* and have more contrasting shades of brown; they are separated from that genus by the presence, on the adult, of a preapical spur on the fore tibia. Larvae of most species of *Acantholyda* in B.C. are usually solitary feeders. The larvae range in color from pale yellow when small, through green and mottled brown, to pink and orange in the prepupal stage.

DISTINGUISHING CHARACTERISTICS

Larvae differ from *Cephalcia* by the relative lengths of the segments of the body appendages. Another distinguishing characteristic is the shape of the anal plate, which can be used to separate species: *A. brunnicans* has the divisions of the anal plate more oval than the sub-angular ones of *A. verticalis*. Adults of these species are separated on the basis of body color. Larvae chew and web foliage below the opening shoot. The tapered vertical larval tunnels, coated with frass, are distinctive from the silky meandering tunnels of most lepidopterous larvae.

MITES

Acarina
[Fig. 23]

DISTRIBUTION and HOSTS

All *Pinus* spp. in B.C. host a variety of mites - phytophagous, predaceous and omnivorus.

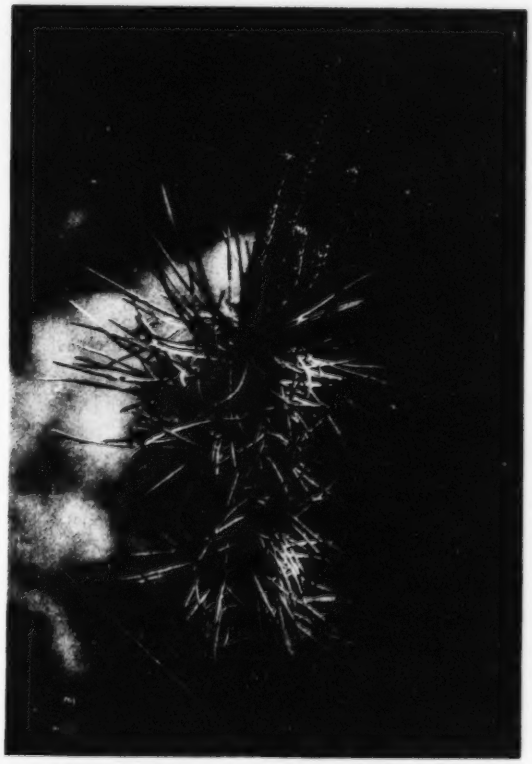


Fig. 23 Lodgepole pine foliage injured and discolored by eriophid mites.

APPEARANCE

Only the plant feeders of families Nalepellidae (Eriophyidae), Tenuipalpidae and Tetranychidae would seem to be of consequence. The cylindrical microscopic nalepellid larvae burrow in young bud tissue and may cause stunted/deformed needles or possibly bud mortality; those most commonly found usually belong to the genus *Trisetacus*. Tetranychid larvae, often known as spider mites, and tenuipalpids - false spider mites, are mostly surface feeders, usually associated with fine dirty webbing. Their feeding may kill the needles and, in extreme instances, large areas of twig growth. Sporadic and localized mite populations may occur in any pine area, particularly on growth that is less than vigorous, and reach their peak during early summer (Silver and Ross 1959, p. 96).

DISTINGUISHING CHARACTERISTICS

The small size of mites, their habits, and the usual presence of eight legs helps distinguish them from insects.

SPITTLE BUGS

Aphrophora spp.
(Homoptera: Cercopidae)
[Figs. 24a, 24b]

DISTRIBUTION and HOSTS

Several closely related species of these sucking bugs are sporadically common throughout B.C. on many host plants; *A. permutata* Uhler and *A. annulata* Ball are the species usually found on pines.

APPEARANCE and
DISTINGUISHING CHARACTERISTICS

The adult is approximately 10 mm long. The pointed head and tapered body each appear triangular in outline and cross section; the wing covers are mottled brown. The distinctive frothy white "spit bubbles" on the plant stems, where solitary angular green/yellow/pink nymphs are feeding, are easily seen. Both nymphs and adults suck the juices from foliage and small stems which is doubtless detrimental to the trees, particularly the more concentrated and extended nymphal feeding on young pines (Rose and Lindquist 1973, pp. 77-78). There are no B.C. records of severe damage. Eggs overwinter on the plant twigs.

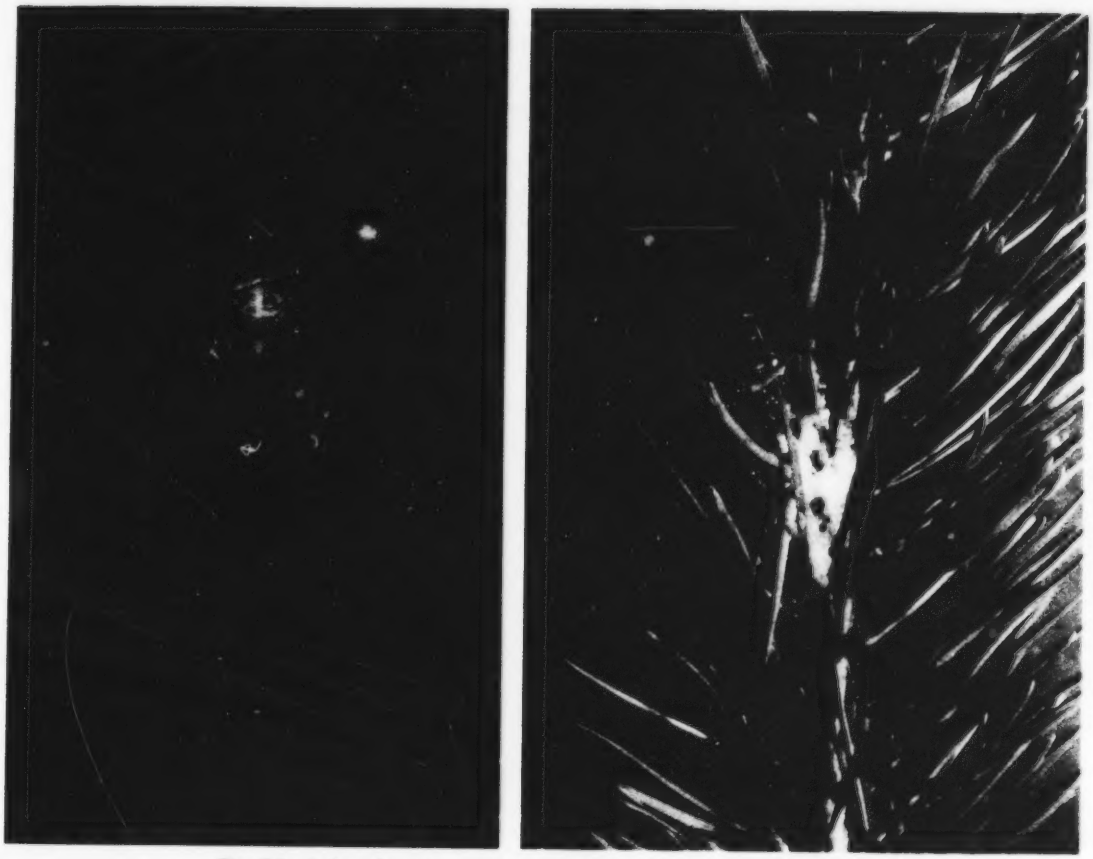


Fig. 24 *Aphrophora permutata*: a. adult. b. frothy larval shelters.

A PINE LEAF-ROLLER

Argyrotaenia tabulana Freeman
(Lepidoptera: Tortricidae)
[Fig. 25]

DISTRIBUTION and HOSTS

This defoliator is found in southern B.C. on *P. contorta,* and is more common in the eastern part of the province where it is sometimes on *P. monticola.*

APPEARANCE

The moth has a wingspan of about 15 mm; the forewings are irregularly banded in shades of contrasting brown; rear wings are dark grey-brown. The green larva is about 9 mm long, with a lighter head and thoracic shield.

LIFE CYCLE

Adults emerge March to May; larvae commence feeding during early summer as miners, and then later bind the needles together into irregular tube-shelters. Larvae usually drop to the ground litter during the autumn to pupate. Occasionally this insect reaches infestation proportions in localized areas.

A LEAF BINDER

Chionodes retiniella Barnes and Busck
(Lepidoptera: Gelechiidae)
[Fig. 26]

DISTRIBUTION and HOSTS

C. retiniella is found throughout the southern range of ponderosa pine in B.C.; it is rarely present on other conifers.

APPEARANCE

The moth, approximately 17 mm in wing-

Fig. 25 *Argyrotaenia tabulana:* defoliation and dead needles on lodgepole pine.

spread, is cream-yellow marked with irregular light brown bars; rear wings are shaded pale grey. The larva is very slender, about 9 mm long, shaded brown with a dark head and thoracic shield. It mines at least 2 needles, then chews along the mid-sections of other needles, before finally forming an individual tube-shelter in the foliage by tightly webbing three to several needles together. The shelter is usually near the branch tip, and seldom on very young trees. The larvae are solitary feeders, but when many are present, each one destroying several needles, considerable damage results as evidenced by the tufts of brown foliage.

DISTINGUISHING CHARACTERISTICS

The neat, long feeding-shelters are distinctive.

A BUD FEEDER

Chionodes sp.
(Lepidoptera: Gelechiidae)

DISTRIBUTION and HOSTS

This unidentified species occurs throughout B.C. on all native *Pinus* spp., although it is seldom found in the north or on *P. monticola.*

Fig. 26 *Chionodes retiniella*: larval feeding damage on ponderosa pine.

APPEARANCE

The slender moth, about 10 mm in wingspread, is mottled dark grey, usually with a pale subapical bar on the forewing. The larva is relatively slender, pale grey-brown with a nearly black head and small thoracic shield; setae and setal bases are inconspicuous.

LIFE CYCLE

There is considerable seasonal adaptation within the life cycle; adults may be present from early June to late July. Eggs are laid singly and the young larva overwinters under a twig or bud scale. Most of the feeding is done during the spring, and the site is characterized by a tunnel of pale webbing and loose frass on the twig-stem or through the new foliage; feeding may also be in the buds or young cones. Most buds are damaged basally rather than in the center, and foliage loss is inconsequential. The insect is frequently associated with *Rhyacionia buoliana* and *Dioryctria* spp.

DISTINGUISHING CHARACTERISTICS

In habit and appearance the larva most closely resembles *Epinotia hopkinsana,* but is smaller and more active, and darker in color. The feeding area is usually more exposed than that of *R. buoliana,* with more pale webbing, less frass, and seldom any pitch, as the larva tends to be a surface feeder rather than a borer. A closely related but larger species, *C. continuella* (Zeller), is similar in habit and appearance, with wider host range and geographic distribution; the pale markings on the adult are more numerous.

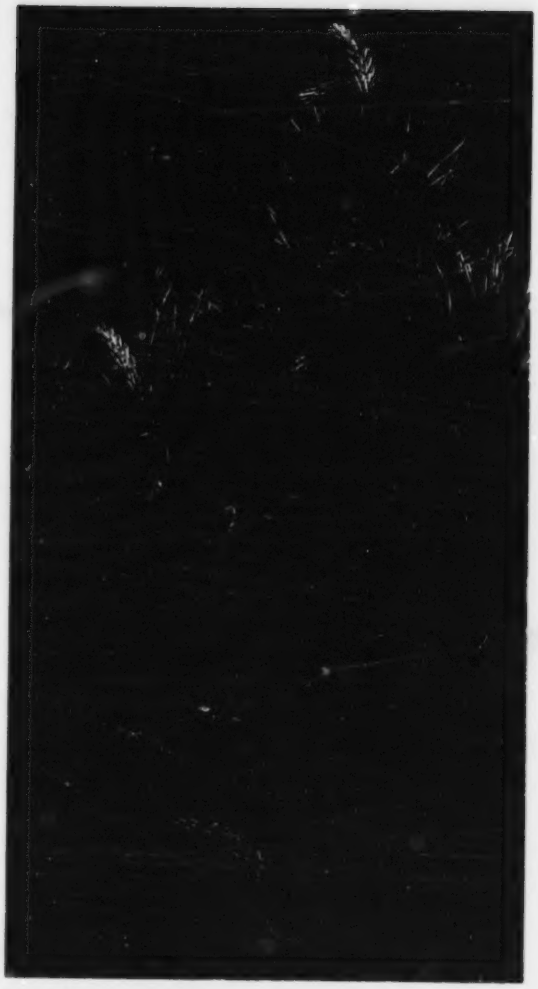


Fig. 27 *Coleotechnites starki:* mined needles on lodgepole pine.

A LODGEPOLE PINE NEEDLE MINER

Coleotechnites (Recurvaria) starki (Freeman)
(Lepidoptera: Gelechiidae)
[Fig. 27]

DISTRIBUTION and HOST

Formerly confused with *C. milleri* (Busck), this species is found mainly in southeastern B.C. on lodgepole pine.

APPEARANCE

The slender adult, about 11 mm in wingspan, is shaded brown-grey. The larva is about 5 mm long, dull green with a near-black head.

LIFE CYCLE

Adults are present during mid-summer and eggs are laid on the needle bases, usually in the sheath. The larva overwinters in a partly mined needle and in the spring completes the excavation and moves to the mid-section of a needle on new growth, in which it again overwinters; its 2-year life cycle is completed the following spring, after it has transferred to a third needle for final feeding and pupation. Foliage discoloration and drop is usually the only damage by this insect in B.C.; however, severe or prolonged infestations can weaken the trees so that they become susceptible to other pests (MacKay 1948, p. 94). A smaller *Coleotechnites* species, with a 1-year cycle, is also found in southern B.C. on lodgepole pine.

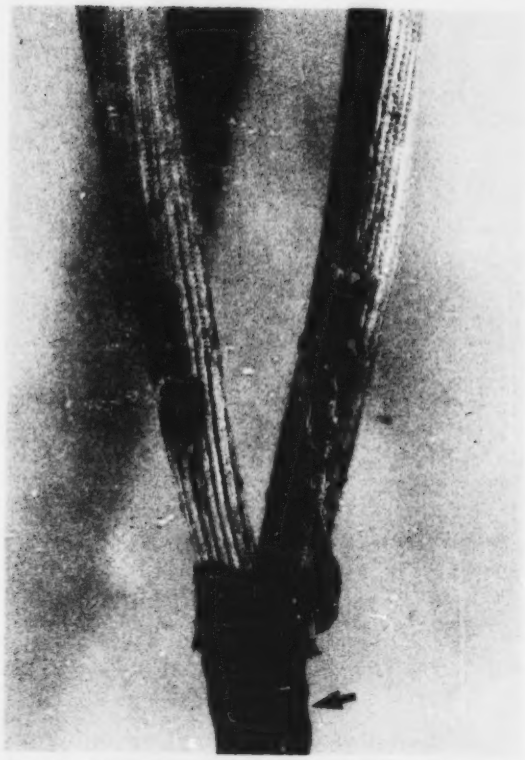


Fig. 28 *Coleotechnites* sp.: two mined needles and a cocoon (at the lower front of the sheath), from a shore pine twig tip.

A NEEDLE MINER

Coleotechnites sp.
(Lepidoptera: Gelechiidae)
[Fig. 28]

DISTRIBUTION and HOST

This species has been found only on shore pine along the southern coast.

APPEARANCE

The slender pale silvery brown-grey moth has a wingspan of about 10 mm. A mature larva is about 5 mm long, widest at the mid-section; cream-colored with a small near-black head and pale brown thoracic and anal shields; a prepupal larva is pink.

LIFE CYCLE

The adult emerges during late April or early May, and eggs are laid on the expanding buds. The egg hatches in mid-summer and the larva bores into a needle, usually on the inner surface well above the sheath. The larva feeds in the needle (away from the base) intermittently throughout the winter until late March, when it webs a feeding site between the other needle of the fascicle just above the sheath; occasionally the second needle is mined. About 3 weeks later it moves down to the twig and spins a patch-like dark grey cocoon. Each larva kills only one or two needles.

DISTINGUISHING CHARACTERISTICS

The insect is most easily located and identified by its damage: one or two mined needles with a small amount of fine light brown frass loosely webbed below the mine. It differs from the more damaging species of *Coleotechnites* in that it matures much earlier in the year, and mines inside the needle above the sheath rather than chewing the bases of the needles within the sheath. This, and the small size of the insect and its frass, separates it from most of the other species that begin their feeding by leaf-mining.

GALL MIDGES

Contarinia spp.
(Diptera: Cecidomyiidae)

A BUD GALL MIDGE

A common bud gall midge is found in southern B.C., more often on *P. contorta* than on *P. ponderosa*. In habit and appearance it is similar to the *Cecidomyia* sp. that causes crooked shoots (p. 15), but is much less numerous; it tends to be more solitary and lives closer to the surface of the bud, sometimes causing resinosis. Adults are identified by wing venation.

A FLOWER GALL MIDGE

Another species of *Contarinia* feeds in the male flowers of lodgepole pine in central and southern B.C.; it is frequently abundant but apparently unimportant. In general appearance and habits, the tiny cream-colored larvae resemble the more common *Xyela* sawflies (p. 49), but they can easily be distinguished by their legless maggot form, and are usually more widely distributed in smaller numbers.

A SHOOT BINDER

Epinotia sp.
(Lepidoptera: Olethreutidae)
[Fig. 29]

DISTRIBUTION and HOSTS

This olethreutid occurs throughout southern B.C. on *P. contorta,* and is most common in the central interior; occasionally it is found on exotic pines.

APPEARANCE

The moth has a 10-15 mm wingspread, and is finely patterned in variegated brown and grey. A larva is about 10 mm long, and is pale green-brown with a nearly black head and thoracic shield, small dark setal bases on pale pinnaculae, and relatively long fine pale setae.

LIFE CYCLE

The larva, at an early instar, overwinters between the bud scales, and heaviest feeding commences as the candles develop, about early June. The feeding shelter is distinctive: a larva inconspicuously webs two adjoining candles closely together, often near their mid-sections. Although terminal shoots are utilized, the actual damage is slight, as the feeding is on the needles rather than on the twig-stem, and the needles outgrow the webbing. Larvae are solitary, but are usually common within very localized areas.

Fig. 29 *Epinotia* sp.: a larva outside its web-shelter between candles on a lodgepole pine.

BUD BORERS

Ernobius spp.
(Coleoptera: Anobiidae)
[Fig. 30]

DISTRIBUTION and HOSTS

Several species of *Ernobius* are found in B.C., among them, *E. pallitarsis* Fall on ponderosa pine in the interior, and *E. punctulatus* (Leconte) on shore pine at the coast.

APPEARANCE

The smooth cylindrical beetles are about 5 mm long, rounded at the ends, with fine appressed hairs; their color varies from orange-brown to nearly black. The most common feeding sites are in injured, stunted, dying or dead terminal buds, but young cones and lateral buds are frequently used, and occasionally twig-stems.

LIFE CYCLE

Eggs are laid during late summer or autumn, and the young larvae overwinter in the buds. One to five larvae may develop in a bud, and most of the feeding is done during early spring. The center of the bud is eaten out to form a single smooth chamber for each larva. The adults emerge from early June throughout the summer and, except for the discolored bud, there is little external evidence of the

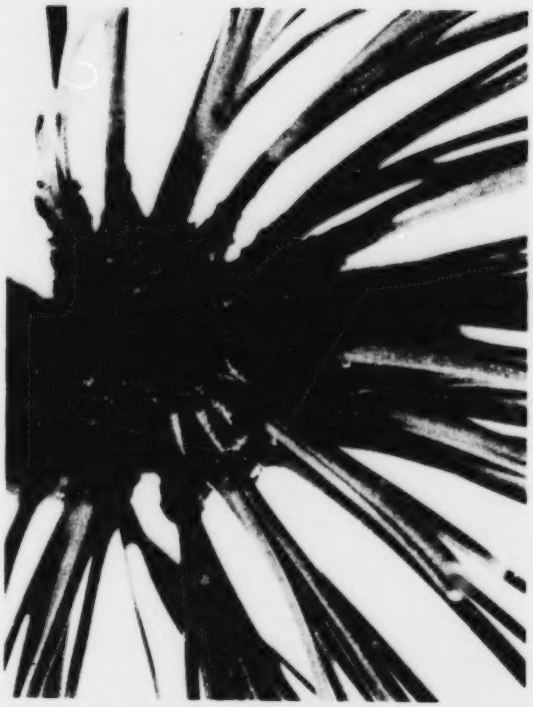


Fig. 30 *Ernobius* sp. feeding chambers in a terminal bud on ponderosa pine.

insect until an emergence hole is bored. Occasionally, at the coast, late developing adults will remain in the buds through the winter.

DISTINGUISHING CHARACTERISTICS

The absence of ventral prolegs immediately distinguishes the larva from a lepidopterous borer, and the hairy appearance is usually enough to separate it from most other beetle larvae that might be found. The symmetrically smooth single feeding chambers are themselves distinctive.

A PINE CONE MOTH

Eucosma rescissoriana Heinrich
(Lepidoptera: Olethreutidae)

DISTRIBUTION and HOSTS

This common cone borer is found throughout the southern interior of B.C., on both lodgepole and western white pines; a closely related species, *E. ponderosa* Powell, occurs on ponderosa pine.

APPEARANCE

The moth resembles that of *E. sonomana* (p. 25), but is lighter brown and less silvery. The larva is pale grey-green with a near-black head and thoracic shield.

LIFE CYCLE

Eggs are laid near or on the second-year cones during April and May, and the larvae chew irregular cavities into the cones during the summer; frass and pitch are usually conspicuous. Larvae will also web and feed at the base of nearby foliage. Young cones are killed and older ones may be severely damaged. A larva may feed on more than one cone. It leaves the cone in late summer and overwinters as a pupa. The species has been recorded as causing significant seed loss (Hedlin 1974).

THE SILVER SPOTTED TIGER MOTH

Halisidota argentata Packard
(Lepidoptera: Arctiidae)
[Figs. 31a, 31b]

DISTRIBUTION and HOSTS

This defoliator is common in southwestern B.C. and is found occasionally as far north as Prince Rupert and east of the coast mountains. It occurs on *P. contorta* but feeds mainly on other conifers (Silver 1958).

APPEARANCE

The robust adult has a wingspread of about 40 mm; the forewings are brown with cream-colored spots; the rest of the insect is mostly pale yellow with brown markings. The fuzzy young larva is pale green with dark spots; an older larva may be almost 40 mm long: black, densely covered with bright yellow, brown and black hair tufts. The glossy stubby pupa is in a hair cocoon, usually located away from the feeding site.

LIFE CYCLE

Eggs are laid during August, in clusters near the ends of the main branches, usually on mature trees. During September the colonial larvae begin feeding on the foliage, from a webbed shelter that becomes progressively larger as it is relocated along the branch. Mature larvae disperse the following spring and become solitary feeders. Large areas of a branch may be defoliated but the damage is not serious because the buds and new foliage are not destroyed.

Fig. 31 *Halisidota argentata:* a. a mature larva. b. defoliation to the top of a shore pine.

Fig. 32 *Hydriomena californiata:* a larva outside its shelter in the male flowers of shore pine.

A TWIG DEFOLIATOR

Hydriomena californiata Packard
(Lepidoptera: Geometridae)
[Fig. 32]

DISTRIBUTION and HOSTS

This brown looper is found in the immediate coastal area of B.C. on shore pine, as well as on other conifers.

APPEARANCE

The fragile moth is about 19 mm in wingspan, shaded with irregular bands of variegated grey-brown; rear wings are much paler. A mature larva, which may attain a length of 22 mm, appears relatively stout and slightly flattened; it is intricately patterned in dark brown, often with a greenish ventral surface, and has long fine sparse hairs.

LIFE CYCLE

The adult emerges in early summer and lays eggs singly on small twigs or nearby foliage. The small red-banded larva feeds near a needle base and usually shelters on the twig. It overwinters as third instar, usually webbed inside a terminal cluster of dead flowers, which it also uses as a shelter during its tip feeding in the spring. The webbed cocoon is often made at the same site. The solitary feeding on old foliage causes only minor damage.

DISTINGUISHING CHARACTERISTICS

The larva can superficially resemble a *Dioryctria,* but has only one pair of abdominal prolegs.

A BARK WEEVIL

Lechriops (Gelus) californicus (Leconte)
(Coleoptera: Curculionidae)
[Fig. 33]

Fig. 33 ***Lechriops californicus:*** an adult emerging from ponderosa pine bark.

DISTRIBUTION and HOSTS

This distinctive snout beetle is found throughout B.C. on all *Pinus* spp.

APPEARANCE

The small, stubby, angular adult is about 3 mm long; black, conspicuously mottled with brown and white scales; the legs are relatively stout.

LIFE CYCLE

The adult overwinters and eggs are laid singly in the bark during early spring. The gallery is an irregular chamber on the wood, and there is little surface evidence of it until an emergence hole is made. Twigs are usually thick enough to withstand average infestations in them. The adult beetles are commonly found on foliage, but their feeding would seem to be insignificant.

A BLUE TWIG-BEETLE

Magdalis lecontei Horn
(Coleoptera: Curculionidae)
[Fig. 34]

Fig. 34 ***Magdalis lecontei:*** an adult on ponderosa pine foliage.

DISTRIBUTION and HOSTS

This small dark snout beetle occurs throughout the range of ponderosa pine in B.C., and is most common on that pine, although also found on other tree species.

APPEARANCE

The dark blue beetle is about 5 mm long, tapered anteriorly, with a conspicuous curved beak. The curled, white legless larva is about the same length.

LIFE CYCLE

Eggs are laid in the twigs during mid-summer; larvae develop in the wood until the following spring, and adults emerge during mid-spring through early summer. Larval boring may be far enough down the twig that the terminal is not killed. The irregular tunnels are packed with fine sawdust rather than the shavings typical of some other pine weevils. The adults are commonly seen on the trees and their feeding habit of chewing below the mid-sections of the new needles can cause loss of foliage (Silver and Ross 1963, p. 117). Several other species of *Magdalis* are found in B.C. on diverse hosts, including *Pinus*.

Scale lines on photographs represent the actual size of the insect.

Fig. 35 *Neophasia menapia:* mature larvae on ponderosa pine foliage.

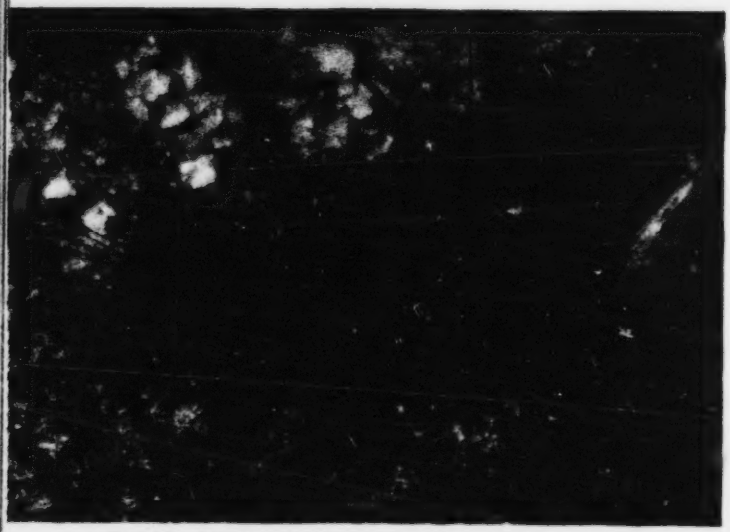


Fig. 36 *Orgyia a. badia:* a semi-mature larva.

THE PINE BUTTERFLY

Neophasia menapia (Felder and Felder)
(Lepidoptera: Pieridae)
[Fig. 35]

DISTRIBUTION and HOSTS

This relative of the cabbage butterfly is found throughout B.C. on several species of conifers, including all native *Pinus,* and is most common in the south. In the interior it usually feeds on pine; at the coast it is most often on Douglas-fir.

APPEARANCE

The white adult has a wingspan of about 50 mm; wingtips and underside venation are black, particularly on the female. The conspicuously ribbed green eggs are laid anglewise in single rows along the upper surface of the needles. A larva is about 40 mm long; soft, cylindrical and narrowly tapered; almost black when small but becoming green with two yellow-white stripes along each side. The green and white chrysalis is suspended in the foliage near the feeding site. The conspicuous butterflies frequently are noticed during late summer among the tree tops.

LIFE CYCLE

Eggs overwinter, and larvae appear in late spring. They are colonial until half grown, and feeding is commonly on the older crown foliage of the trees. Although the large numbers of adults attract attention, in B.C. noticeable defoliation seems limited to ponderosa pine and seldom has been a problem (Silver and Ross 1965, p. 117).

TUSSOCK MOTHS

Orgyia spp.
(Lepidoptera: Lymantriidae)
[Fig. 36]

DISTRIBUTION and HOSTS

The Rusty Tussock Moth, *Orgyia antiqua badia* (Henry Edwards), commonly occurs throughout B.C. on a wide variety of coniferous and deciduous plants. It will feed on any of the native pines but is most often found on *P. contorta.*

APPEARANCE

The male moth has a wingspan of about 26 mm; the rounded wings are shaded ochre-brown, with a small white spot near the hind angle; the fat

female moth, about 13 mm long, is brown-grey and wingless. The off-white eggs are laid in a flat mass on the cocoon, which is spun of larval hair, often on the stem or foliage near the feeding site. A mature larva is about 25 mm long, with a "toothbrush" of yellow hair in the middle, conspicuous long black hair tufts at each end - 2 in front, 1 at the rear; and fluffy body hairs over an intricately lined pattern shaded yellow, brown, grey and black, with orange dorsal tubercles.

LIFE CYCLE

Winter is spent in the egg stage and the larva feeds through early summer. The pupal stage is brief and the adult appears during mid-July through early September. The insect is often a solitary feeder, but populations of infestation proportions have occurred rarely on lodgepole pine in south-central B.C. (Monts 1976).

The Douglas-fir Tussock Moth, *O. pseudotsugata* (McDunnough), a closely related and generally darker species, occurs in southern B.C., mostly in the interior, where it sometimes moves onto ponderosa or lodgepole pines when Douglas-fir is in short supply.

A FOREST CUTWORM

Panthea portlandia Grote group
(Lepidoptera: Noctuidae)
[Fig. 37]

DISTRIBUTION and HOSTS

This large solitary cutworm occurs throughout B.C. on all native species of pines.

APPEARANCE

The moth has a wingspan of about 40 mm; it is white-grey so thickly shaded with irregular dark grey bands as to sometimes appear nearly black. A larva may reach 45 mm in length; it is variably white, yellow, brown and/or grey, with moderately long sparse hair and conspicuous black hair tufts on the front, back and mid-section. The cocoon may be in the foliage or on the bark.

LIFE CYCLE

The pupa overwinters and the adult emerges during late spring - early summer. The solitary larva feeds July - September. The insect attracts attention because of its large size and colorful pattern.

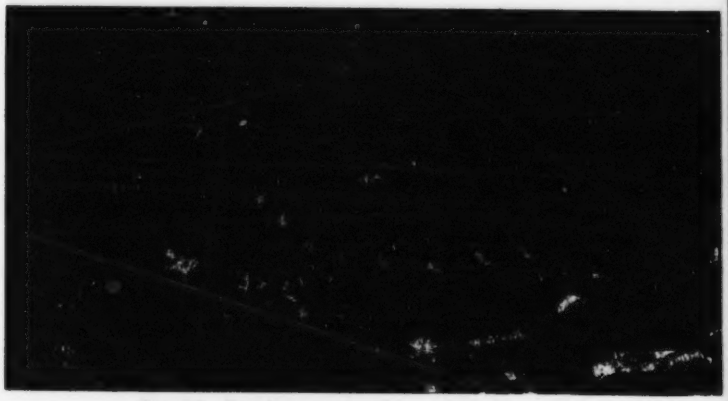


Fig. 37 *Panthea portlandia:* a mature larva.

Fig. 38 *Petrova albicapitana:* a branch of lodgepole pine dying from the effects of *Petrova* feeding in the gall at lower left.

PITCH TWIG MOTHS

Petrova spp.
(Lepidoptera: Olethreutidae)
[Fig. 38]

DISTRIBUTION and HOSTS

Petrova albicapitana Busck, the Northern Pitch Twig Moth, is found throughout interior B.C. on lodgepole pine; it is found rarely on ponderosa pine, and can also occur in coastal areas on shore pine.

APPEARANCE

The adult, approximately 19 mm in wingspan, is variably and obscurely patterned with

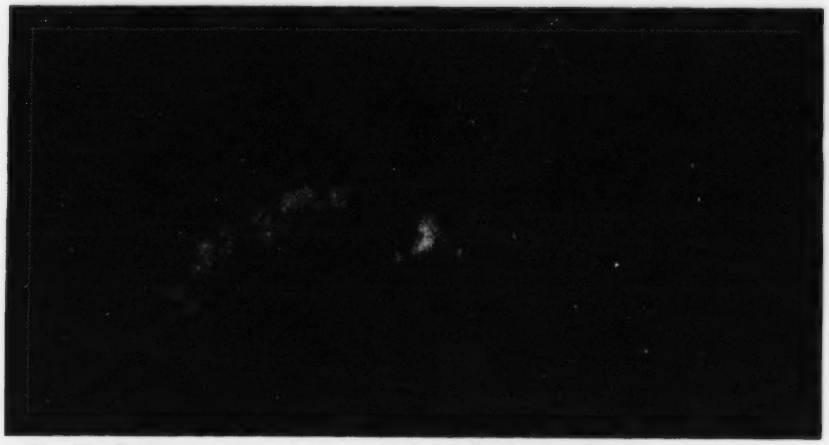


Fig. 39 *Puto cupressi*: cottony nymphs and a dead female, between ponderosa pine needles from which the sheath has been removed.

irregular bands of pale brown, shaded with dark grey. The larva, about 15 mm long, is pale grey-brown with a brown head and thoracic shield, and large conspicuous dark setal bases.

LIFE CYCLE

Adults are active during June, and deposit eggs singly on the candles. The young larva presently makes a lumpy, shell-like pitch blister below the summer's growth in which to overwinter. The following summer it chews out bark farther down the young branch and forms a pitch nodule, often at a twig or branch axil. Nodules are irregularly globose and may be more than 30 mm diameter. The larva overwinters a second time and pupates during early spring in the pitch chamber. The pitch nodules are conspicuous on the branches, and larval feeding may weaken the branch. When, occasionally, the larva remains on terminal growth, it may bore into the twig and stunt or kill the terminal.

DISTINGUISHING CHARACTERISTICS

The relatively smooth globular appearance of the dark, hollow pitch shelter is usually sufficient to separate *Petrova* from pitch moths or *Dioryctria* spp. For atypical feeding sites on young growth: the larval coloration is distinct from *Synanthedon*, and the color and smaller size will usually separate *Petrova* from *Dioryctria*.

P. metallica Busck is found throughout southern B.C., mostly on ponderosa pine in the interior. The moth is dark grey; otherwise it is much like *P. albicapitana* in appearance and habit.

A PINE MEALYBUG

Puto cupressi (Coleman)
(Homoptera: Coccidae)
[Fig. 39]

DISTRIBUTION and HOSTS

This soft-bodied bug is found at higher altitudes in the southern interior of B.C. on lodgepole pine, ponderosa pine and other conifers (Grant 1964).

APPEARANCE

Adult females are flat-ovoid, about 5 mm long; pale brown but densely covered with a waxy white powdery secretion. They are frequently associated with pad-like egg masses.

LIFE CYCLE

The life cycle takes more than 1 year and includes seasonal migration of the young crawler stage. Adults and nymphs may be found on any part of the tree, including the root crown, but are most often found between the needles under the sheath. The felty white cocoons of the males are usually on the foliage. Severe infestations produce gouting of the twigs and branches, and can cause mortality. Twigs and branches may become black with sooty fungus on the insect exudate.

DISTINGUISHING CHARACTERISTICS

The gout damage is superficially similar to that of the Balsam Woolly Aphid, *Adelges piceae* (Ratzeburg), but the latter does not occur on pine.

Fig. 40 *Rhyacionia busckana:* a larval "bubble" shelter at tip of shoot – note missing needles.

A PINE TIP DEFOLIATOR

Rhyacionia busckana Heinrich
(Lepidoptera: Olethreutidae)
[Fig. 40]

DISTRIBUTION and HOST

R. busckana is found in the southern interior of B.C. on ponderosa pine.

APPEARANCE

The moth has a wingspread of about 15 mm; forewings are reddish-brown with fine grey stippled basal bands; rear wings are grey. A larva is approximately 8 mm long, usually quite fat: shiny brown with a small black head and narrow thoracic shield; it becomes paler as it matures, shading to pink before it pupates.

LIFE CYCLE

Eggs are laid singly on the terminal buds during late summer, and the larva overwinters in a bud, without much feeding. During June, the larva constructs a filmy bubble-like pitch shelter near a terminal bud and feeds within the sheaths of the new apical needles; several needles may be killed. Pupation is usually within the shelter, and adults emerge July - September. In B.C., the insect has been found only on small young trees, and seldom on vigorous growth.

DISTINGUISHING CHARACTERISTICS

The larva is paler and puffier than *R. buoliana,* feeding in the needle sheath rather than in the bud. Its translucent bubble shelter is inconspicuous but distinctive.

A BLACK PINE-APHID

Schizolachnus curvispinosus HEK
(Homoptera: Aphididae)

DISTRIBUTION and HOST

This common bug is found on the foliage of ponderosa pine in the southern interior.

APPEARANCE and LIFE CYCLE

The spring nymphs, in May and June, are frequently noticed. Individuals are about 3 mm long; robust, appearing slightly flat with relatively short legs; they are black with short threads of white waxy secretion. They tend to be gregarious and form rows on the needles, especially when young. Their feeding causes leaf spotting and a small amount of leaf mortality.

DISTINGUISHING CHARACTERISTICS

Their appearance separates them from the long-legged shiny brown *Cinara* aphids, and from the fragile white woolly *Pineus. S. piniradiatae* (Davidson) is similar in habit but less common.

A GREEN PINE-WEEVIL

Scythropus elegans (Couper)
(Coleoptera: Curculionidae)
[Fig. 41]

DISTRIBUTION and HOSTS

This small snout beetle is found throughout B.C. on all *Pinus* spp., and on some other conifers, but is most common on *P. ponderosa.*

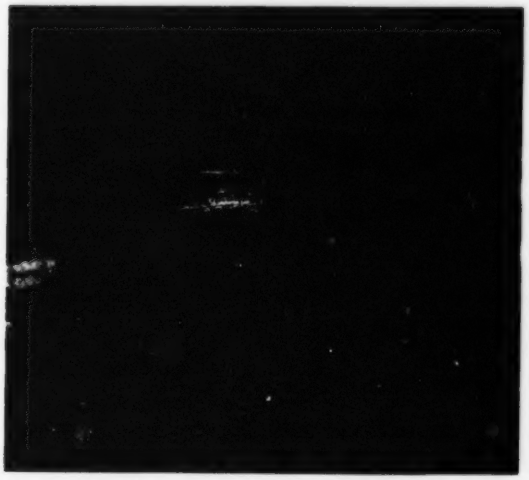


Fig. 41 *Scythropus elegans:* an adult, with little green coloration.

APPEARANCE

The adult weevil is about 5.5 mm long, wider toward the posterior; it has a relatively short beak. Commonly it is an irridescent green shaded in a slightly linear pattern; some beetles may be grey, brown or nearly black. The adult feeds on the foliage, serrating the needle margins and sometimes severing the needles. Occasionally, when large numbers of weevils occur, foliage may be killed. *S. californicus* Horn is a slightly stouter grey and brown species, more common at the coast.

THE SEQUOIA PITCH MOTH

Synanthedon (Vespamima) sequoiae (Henry Edwards)
(Lepidoptera: Sesiidae)
[Fig. 42]

DISTRIBUTION and HOSTS

This conspicuous pest is found throughout B.C., but is most common in the south. It occurs on all native species of pines, and occasionally on other conifers.

APPEARANCE

The clearwing moth has a wingspan of 13-30 mm. The slender black and yellow-banded body gives it a wasp-like appearance. A larva may be 28 mm long; it is almost white with a pale brown head and thoracic shield, and short brown setae on inconspicuous bases.

Fig. 42 *Synanthedon sequoiae:* damage to a terminal twig – an atypical site.

LIFE CYCLE

The adult appears during the summer and oviposits on the pine bark. The larva soon bores into the bark and may take 1 or 2 years to mature; it is commonly in a pitch mass on a stem or branch, particularly at an axil, and can weaken the tree significantly (Silver and Ross 1961, p. 104).

DISTINGUISHING CHARACTERISTICS

Although primarily on the trunk or branches, this insect is found occasionally on the leaders of young shore pine, where it superficially resembles a *Dioryctria;* however, the absence of dark setal bases distinguishes the pitch moth larva, and the greater abundance of pitch is also characteristic.

Scale lines on photographs represent the actual size of the insect.

Fig. 43 *Tolype dayi*: a mature larva.

A PINE LAPPET MOTH

Tolype dayi Blackmore
(Lepidoptera: Lasiocampidae)
[Fig. 43]

DISTRIBUTION and HOSTS

This stout grey insect is found across southern B.C. on *P. contorta* and sometimes on *P. ponderosa*. It can also occur on other conifers, particularly Douglas-fir and hemlock (*Tsuga heterophylla* (Raf.) Sarg.), at the coast.

APPEARANCE

An adult is about 35 mm in wingspread, white-grey with irregular fine bands, and very hairy. The larva may be 40 mm long: wide, flattened, dark grey with a fringe of fluffy hair tufts along the lower sides. The pupa is in a grey felty cocoon, often in the foliage near the feeding site.

LIFE CYCLE

The solitary larva feeds during July - August, and there is a brief pupal period before the adult appears August - September. Winter is passed in the egg stage. The insect is not common enough to cause any defoliation problems.

FLOWER FEEDING SAWFLIES

Xyela spp.
(Hymenoptera: Xyelidae)
[Fig. 44]

DISTRIBUTION and HOSTS

These small insects are found throughout B.C. on all native *Pinus* spp., most commonly at lower elevations in the southern interior.

Fig. 44 *Xyela* sp. larvae removed to the surface of infested male flowers on ponderosa pine.

APPEARANCE

An adult is about 4 mm long, patterned in brown, grey and black; the basal segments of the antennae are very long. In most species the larva is about 5 mm long, allover cream-yellow.

LIFE CYCLE

The adults appear during mid-spring and most species oviposit in male flower buds. The larvae feed within the maturing flower clusters, sometimes in considerable numbers. They drop to the ground in early summer and the pupae overwinter in the soil litter.

DISTINGUISHING CHARACTERISTICS

The presence of small ventral prolegs distinguishes the xyelid larva from that of a young beetle; and the color alone separates it from most Lepidoptera that could be found in pine flowers.

Fig. 45 *Zale d. largera:* a mature larva on lodgepole pine foliage.

A PINE CUTWORM

Zale duplicata largera Smith
(Lepidoptera: Noctuidae)
[Fig. 45]

DISTRIBUTION and HOSTS

This slender caterpillar is found throughout B.C. on *P. contorta* and occasionally on *P. monticola,* most commonly in the southeast.

APPEARANCE

The moth is about 36 mm in wingspan, heavily shaded in irregular bands of sombre grey-brown. The larva may be more than 40 mm long, and is distinguished by its gradated pairs of prolegs; the color varies from bright pale ochre to dark grey-brown, and the pattern is linear with shaded banding – a wide pale lateral stripe is typical.

LIFE CYCLE

The adult is present during late spring, sometimes much earlier at the coast, and eggs are laid on the foliage; the larva feeds during the summer and pupates below the ground litter to overwinter. Defoliation generally occurs on branch terminals but, as the larva is usually a solitary feeder, the damage is insignificant.

ASSOCIATE INSECTS

INCIDENTAL FEEDERS

Insects commonly noticed, but primarily feeders on other parts of the tree or on other host plants (approximately 300 other species on record).

	Host Trees			
	P. c. contorta	*P. c. latifolia*	*P. monticola*	*P. ponderosa*
Carineta spp. (Lepidoptera: Geometridae) Medium-size grey-brown and yellow loopers occurring in late summer; defoliators consistently found in small numbers.	●	●	●	●
Chalcophora angulicollis Leconte (Coleoptera: Buprestidae) A large (30 mm) robust flat-headed beetle; the metallic dark grey and coarsely sculptured adult may be found on sunny trunks or foliage.				●
Chlorochroa spp. (Hemiptera: Pentatomidae) Large green stink bugs, solitary and slow moving; they suck sap from the foliage.	●		●	●
Dichelonyx spp. (Coleoptera: Scarabaeidae) Stout-bodied leaf-chafer beetles; irridescent green, brown and black; found on the foliage, which they sometimes chew unevenly.		●	●	●
Ectopsocus californicus Banks (Corrodentia: Psocidae) A tiny active, translucent, grey bark-louse; often numerous on twigs, branches and tree trunks.			●	●
Gabriola dyari Taylor (Lepidoptera: Geometridae) The larva is a stout grey or brown looper with two wide bands of a paler shade; a solitary defoliator.	●	●	●	●
Glyptoscelis longior Leconte (Coleoptera: Chrysomelidae) The smooth powdery grey adult of this leaf beetle is found on foliage.		●	●	●
Lestodiplosis spp. (Diptera: Cecidomyidae) Small legless yellowish maggots in the bark surface; the pale ovoid cocoons are sometimes on the needles.	●	●		
Melanophila spp. (Coleoptera: Buprestidae) The 1 cm angulate black adults of these flat-headed beetles are often found on the foliage.		●	●	●
Semiothisa spp. (Lepidoptera: Geometridae) The larvae are slender green or brown loopers, usually with a diagonal brown mark on the sides of the head; found in small quantities during mid- or late summer on the foliage.	●	●	●	●
Syngrapha selecta Walker (Lepidoptera: Noctuidae) The stout green and white striped larva of this cutworm has only two pairs of abdominal prolegs; it is a solitary defoliator most often noticed during early spring.	●	●	●	●

PARASITOIDS AND PREDATORS

Common associates of pine insects, but not restricted to them (approximately 220 additional species on record).

Parasitoids / scavengers:

Diptera

Lonchaea spp. (Lonchaeidae)

Hymenoptera

Eurytoma spp. (Eurytomidae)

Itoplectis spp. (Ichneumonidae)

Lamachus spp. (Ichneumonidae)

Rogas spp. (Braconidae)

Scambus spp. (Ichneumonidae)

Predators:

Coleoptera

Adalia spp. (Coccinellidae)

Coccinella spp. (Coccinellidae)

Cycloneda sanguinea (Linnaeus) (Coccinellidae)

Enoclerus spp. (Cleridae)

Hippodamia spp. (Coccinellidae)

Mulsantina picta minor (Casey) (Coccinellidae)

Psyllobora viginti-maculata taedata Leconte (Coccinellidae)

Hemiptera

Gastrodes pacificus Provancher (Lygaeidae)

Hymenoptera

Camponotus spp. (Formicidae)

Formica spp. (Formicidae)

Polistes fuscatus aurifer Saussure (Vespidae)

Neuroptera

Agulla spp. (Raphidiidae)

Chrysopa spp. (Chrysopidae)

Hemerobius spp. (Hemerobiidae)

SHELTERING INSECTS

Insects frequently found on the foliage (approximately 390 other species on record).

Coleoptera

Ampedus spp. (Elateridae)

Anoplodera spp. (Cerambycidae)

Ctenicera spp. (Elateridae)

Cyphon spp. (Helodidae)

Dalopius spp. (Elateridae)

Dysslobus verrucifer Casey (Curculionidae)

Helops pernitens Leconte (Tenebrionidae)

Lacon profusa Candese (Elateridae)

Limonius spp. (Elateridae)

Megapenthes stigmosus Leconte (Elateridae)

Podabrus spp. (Cantharidae)

Prothalpia holmbergi Mannerheim (Melandryidae)

Diptera

Rhamphomyia spp. (Empidae)

Hymenoptera

Hoplopyga spp. (Chrysididae)

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GLOSSARY

Abdominal prolegs - the soft "feet" on the abdominal mid-section of a caterpillar, not the three pairs of hard jointed true legs at the front

Anal plate - the shield-like covering on top of the last visible body segment

Annulate - ringed

Apical - in insects, referring to that part farthest from the head

Candle - the elongated terminal pine shoot, before the needles have fully expanded

Chlorotic - the blotchy yellow appearance of leaf tissue due to fading or loss of chlorophyll

Costal - pertaining, in this instance, to the leading edge of the forewing

Detritus - broken particles of waste matter (foliage, frass, cast skins, boring dust, etc.)

Diapause - a dormant period in the development of an insect

Distal - that part farthest from the body

Exotic - not native; introduced

Fascicle - the individual bundle or cluster of needles

Flagging - an unnatural drooping/discoloration of the terminal growth

Frass - insect excrement

Infuscated - smoky grey-brown

Instar - the period or stage between molts in the larva

Lanceolate - lance- or spear-shaped

Leader - the most recent shoot growth at the apex of a plant, usually on the main stem

Lepidoptera - the insect order of moths and butterflies

Nodule - a swelling; herein referring to an irregular mass of pitch

Nymph - a young insect that superficially resembles the larger adult except for the lack of fully-developed wings and genitalia

Oviposit - to lay eggs

Parasitoid - usually, a parasite that eventually kills its host

Pinnaculum - a small plate-like area in the caterpillar skin, often distinctly colored, on which hairs or setae are mounted

Prepupal - the larval stage immediately preceding the pupa

Pronotum - the front of the thorax; in most adult beetles the segment between the wings and the head

Pupation - the forming of the pupa from the larval stage

Reticulate - covered with a fine irregular network of lines or wrinkles

Sawfly - a thick-bodied wasp, sometimes referred to as a tenthredinid, the larva of which is a plant feeder and resembles a many-legged caterpillar

Sessile - closely attached, relatively immobile

Setal base - the immediate area near the base of a hair or seta

Sheath - a tubular envelope, herein referring to the scale-like protective covering at the base of a fascicle of needles

Spiniform - spindle-shaped; cylindrical, and tapered at both ends

Thoracic shield - the hardened dorsal area immediately behind the head of a caterpillar, sometimes colored like the head

Vertices - the upper apices (of the head capsule)

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INDEX

Page

Acantholyda brunnicans – a web-spinning sawfly 34
Acantholyda verticalis – a web-spinning sawfly 34
Acarina – mites 35
Adelges piceae – the Balsam Woolly Aphid 46
Adelges spp. – woolly aphids 30
Aphrophora annulata – a spittlebug 35
Aphrophora permutata – a spittlebug 35
Aphrophora spp. – spittlebugs 35
Argyrotaenia citrana – the Orange Tortrix 13
Argyrotaenia tabulana – a pine leaf-roller 36

Cecidomyia spp. – gall midges 15
Cephalcia californica – a web-spinning sawfly 16
Cephalcia spp. – web-spinning sawflies 16
Chionodes continuella – a leaf binder 38
Chionodes retiniella – a leaf binder 36
Chionodes sp. – a bud feeder 37
Choristoneura occidentalis – the Western Spruce Budworm . . 17
Cinara brevispinosa – a pine aphid 17
Cinara medispinosa – a pine aphid 19
Cinara ponderosae – a pine aphid 19
Coleotechnites milleri – the Lodgepole Needle Miner 38
Coleotechnites starki – a lodgepole pine needle miner 38
Coleotechnites sp. – a needle miner 19, 39
Conophthorus monticolae – a pine cone beetle 20
Contarinia spp. – gall midges 39

Dioryctria abietivorella – a shoot borer 21
Dioryctria auranticella – a coneworm 22
Dioryctria cambiicola – a pitchworm 22
Dioryctria pentictonella – a shoot borer 24
Dioryctria spp. 21

Epinotia hopkinsana – a tip borer 24
Epinotia sp. – a bud binder 40
Ernobius pallitarsis – a bud-boring beetle 40
Ernobius punctulatus – a bud-boring beetle 40
Ernobius spp. – bud beetles 40
Eucosma ponderosa – a cone borer 41
Eucosma rescissoriana – a cone borer 41
Eucosma sonomana – a shoot borer 25

Halisidota argentata – the Silver Spotted Tiger Moth 41
Hydriomena californiata – a twig defoliator 42

Page

Lechriops californicus – a small bark weevil 43

Magdalis lecontei – a blue twig weevil 43

Neodiprion nanulus contortae – a pine sawfly 28
Neodiprion spp. – sawflies 25
Neophasia menapia – the Pine Butterfly 44
Nuculaspis californica – the Black Pineleaf Scale 28

Orgyia antiqua badia – the Rusty Tussock Moth 44
Orgyia pseudotsugata – the Douglas-fir Tussock Moth 45
Orgyia spp. – tussock moths 44

Panthea sp. – a forest cutworm 45
Petrova albicapitana – the Northern Pitch Twig Moth 45
Petrova metallica – a pitch twig moth 46
Petrova spp. – pitch twig moths 45
Phenacaspis pinifoliae – the Pine Needle Scale 28
Pineus coloradensis – a woolly aphid 29
Pissodes terminalis – the Lodgepole Terminal Weevil 30
Pityophthorus borealis – a small twig beetle 31
Pityophthorus boycei – a pine twig borer 31
Pityophthorus confertus – a small twig beetle 31
Pityophthorus confinis – a small twig beetle 31
Pityophthorus opimus – a small twig beetle 31
Puto cupressi – a pine mealybug 46

Rhyacionia buoliana – the European Pine Shoot Moth 31
Rhyacionia busckana – a tip defoliator 47

Schizolachnus curvispinosus – a black pine-aphid 47
Schizolachnus piniradiatae – a black pine-aphid 47
Scythropus californicus – a brown weevil 48
Scythropus elegans – a green pine-weevil 47
Synanthedon sequoiae – the Sequoia Pitch Moth 48

Tolype dayi – a pine lappet moth 49
Trisetacus spp. – bud mites 35

Xyela spp. – flower sawflies 49

Zale duplicata largera – a pine cutworm 50
Zelleria haimbachi – the Pine Needle Sheathminer 33